THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE MECHANIC ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

FEBRUARY, 1826.

THE following are the Standing Committees of the Franklin Institute, for the year 1826.

On Finance.

Paul Beck, jr.
James M'Alpin
J. Harper
A. G. Ralston
John Richardson

On Instruction.

R. M. Patterson
James Ronaldson
Isaac B. Garrigues
A. G. Ralston
S. V. Merrick

On the Library.

Mathew Carey
Harvey Lewis
Lloyd Mifflin
W. S. Warder
H. J. Reihle

On Models.

John Haviland
James Clark
Lloyd Mifflin
I. B. Garrigues
Rufus Tyler

On Minerals.

P. A. Browne
William H. Keating
John Harrison
Abraham Miller
Thomas P. Jones

On Premiums and Exhibitions.

James Ronaldson
Adam Ramage
Thomas Fletcher
Samuel V. Merrick
William Strickland

On Inventions.

R. M. Patterson
James Ronaldson
James J. Rush
Samuel Humphreys
Thomas P. Jones

On the Hall.

Harvey Lewis
William S. Warder

On Publications.

Mathew Carey
William H. Keating
Thomas P. Jones

FOR THE FRANKLIN JOURNAL.

Observations on the Rise and Progress of the Franklin Institute.

Communities, as well as individuals, may all be said to have their attention and interests excited towards the attainment of certain objects, which, either from chance, inclination, or caprice, they chiefly affect. These hobbies, if we may be permitted the term, acquire more importance when they are supported by numerous individuals, than when forming the object of the hopes and wishes of a single one. Like the favourite schemes, which at various periods of his short life, prompt man to the pursuit of particular objects in preference to all others; so the projects which occasionally start up in Societies, and enlist in their support the talents, exertions and wealth of their members, have been found to vary according to the spirit of the age. New plans have succeeded each other with almost inconceivable rapidity; a few alone subsisting after the excitement to which they owed their birth had worn away, have survived their short-lived projectors; and descending from generation to generation, have acquired an importance proportioned to the lapse of ages through which they have passed. Foremost among these, may doubtless be ranked, the various establishments instituted for the promotion and dissemination of learning. Science and the Arts did not at first attract, as they deserved, the attention of the wealthy and the noble. By them, education was, for a while, despised, as alone becoming the inferior classes of society; and it was deemed the distinctive badge of opulence and high birth, to be among the most ignorant of the land. But when, in the successive political revolutions, which assisted in the progress of those principles of popular representation, upon which all modern governments are founded, it was proved that in-

fluence was the necessary consequence of literary acquirements; that, in the emphatic words of Bacon, knowledge was power; when the experience of the age had made this maxim so evident as to bring conviction home to the minds of the most sceptical, then they who had until that time monopolized all power, found it convenient to extend their views, and to attempt to confine knowledge also within the reach of themselves and their equals. No longer affecting to despise it, they pretended to discover in it something of so insidious a tendency that it could not be imparted to the commonalty without danger to the state; and hence, the literary institutions which, till then, had been fostered by ecclesiastical zeal alone, became endowed by the nobility, while their constitution and laws were re-modelled, with a view to render them difficult of access to any but the privileged orders. The same aristocracy that had for ages monopolized power, honour, and profit, now extended its arms to embrace within its grasp, learning also.

The many changes which have occurred during the last seventy years, have, however, tended altogether to subvert those restrictions, and to place education within the reach of all, whether born in affluence or poverty; whether destined to inherit boundless wealth, or to support themselves by the sweat of their brow. The change was not, however, a sudden one; even the most enthusiastic advocates of popular education, dared not at first to extend their request beyond those rudiments which were necessary for the acquisition of a religious and moral education. That the poor should be instructed in reading and writing, in order that they might be enabled to peruse the sacred scriptures, and to read in the book of wisdom, those maxims intended for the good of all, was a request so reasonable, that it could not but be granted, in spite of the accumulated prejudices of the age. When these had been attained, it was thought desirable to extend these benefits still further; the friends of universal education felt themselves emboldened by the success of their first measures. They had demonstrated that the poor could be instructed, and that no evil consequences would result therefrom to the state. The number of their partizans grew daily more considerable, and the extension and dissemination of education by gratuitous schools, became, by the recent improvements introduced into the art of instruction, an easier task than had been anticipated. Still, many difficulties were met with, one of which arose from the very apathy of those who were to be benefitted by it, holding in contempt, that which they could not understand—they at first objected to submit to the course of intellectual improvement, which was so liberally placed within their reach. Blinded in a few instances, by an unpardonable eagerness after small pecuniary gains, they refused to their children those opportunities of improvement, which would curtail, somewhat, their hours of daily labour. No one can too highly deprecate the infatuation which prevented them from discovering, that the seed of knowledge early implanted in the breast of their children, could not palsy their future efforts, and incapacitate them for la-

borious exertions, but that, on the contrary, by making a call upon the active exertions of the intellectual powers, it would stimulate them, and cause them to assume that development, which would subsequently support the adult individual, in all those difficulties which, in his progress through life, he would have to encounter. From this unfortunate apathy on the part of many, it soon appeared that the education which was thus extended to them gratuitously, became from this very circumstance, of less value. It was held cheap and of no account, because it cost nothing. The attendance upon the schools became irregular, the progress of the pupils was consequently less rapid, and the system itself necessarily fell into disrepute.

We are not able to decide from the information before us, to whom we are indebted for the first great improvement subsequently introduced into education; and which consisted in making the parent contribute somewhat to the instruction of his children. The contribution was so small that it was not beyond the reach of the poorest citizen, that was endowed with even but common industry and common talents; yet it was such, as having been once paid, stamped a certain value upon that education, to which it gave access. He that after having paid for it, did not insist upon his children's punctual attendance upon the schools, felt as if he had suffered himself to be defrauded of his acquired rights, as if he had made an unnecessary sacrifice of his own interest.

The plan is unquestionably of Scotch origin, and we can refer it to the system of parochial schools, so long established in the Highlands of Scotland, and which has secured to the inhabitants of that country, the claim which they justly assert, to rank first among the universally instructed nations of christendom. It has enabled more men of talents among them to start from the common ranks of life, and, by an assiduous and zealous pursuit of learning, to place themselves on a par with the proud aristocracy of their country, and to hold the highest ranks in all departments, whether of science, letters, politics, or the arts. To these early principles of education, which the Scottish cottager imbibes from his tenderest years, as much perhaps, as to national peculiarity, are we to attribute the uniformly prudent, cautious and virtuous character, which has always distinguished the Scotchman through his numerous migrations, and imparted to him the means of thriving in whatever situation chance may have placed him.

Whether, as has been generally believed, the late Dr. Anderson of Glasgow, was the first, who, by his liberal provisions in favour of the Institution, which bears his name, gave a new stimulus to this zeal for public instruction, and excited the mechanics of his large manufacturing town to the acquirement of the general principles of science; or if he only laid, as has since been alleged, the foundation of an Institution which, in its successful efforts to promote the welfare of the labouring classes of the community, suggested to others the plan of the Mechanics' Institutions, of which so many have of late been created, is a question which we do not

choose to discuss. Which ever side may be adopted, it cannot be denied that Anderson's name will descend to posterity, as that of one of the greatest benefactors of the human family; and that the good of which he will have been the direct or indirect cause, will bear an advantageous comparison, with that produced by any other person, whose name stands recorded in History.

Twenty years and more, did the Andersonian Institution continue to extend its useful instruction to all classes, without distinction, when a zealous friend to the same cause arose in the person of Dr. Birkbeck, who, by the establishment of an Institution in Glasgow, and of one in London, made the benefits of this system of popular instruction in science, still better known. Various other societies sprung up about the same time, and the number of Mechanics' Institutions is, at this moment, increasing so rapidly, that we doubt not that ere long, a similar society will be considered indispensable in all large cities. Justice requires us to state, that even before Dr. Birkbeck had invited the attention of the Mechanics of London to this subject, and it is even said, prior to the formation of any association of Mechanics for mutual instruction in Europe, a public spirited gentleman of New York, advantageously known by his scientific and literary publications, as well as by his success in popular lecturing, resolved upon an attempt to unite the Mechanics of his flourishing city, into an institution whose object should be the promotion of the Mechanic Arts, by lectures and by other judicious measures.

It cannot be believed that, in the city of Philadelphia, where so many enlightened and industrious mechanics are daily seen accumulating large fortunes, any backwardness should have existed as to the formation of a similar institution. Nor can it be believed, that in the city where a society of that kind once existed, supported by the names of Franklin, Godfrey and others, that any great difficulty should have existed in realizing so desirable a scheme. We have been told that it was contemplated many years since, by a distinguished gentleman of this city whose efforts were either discontinued or proved unsuccessful, from what cause we know not.

In the mean while, many of our citizens had been made acquainted with the importance of the object, and had become anxious for the attainment of it. A meeting of a few gentlemen, we believe about fifteen, was held at a private house in this city, in the beginning of November, 1822. The subject was fully discussed, and uniting the approbation of all, was referred to a committee to devise means to carry it into operation. Many societies have been originated in our city at various times, all apparently deserving of support, but unfortunately many of them, from various causes, have enjoyed but an ephemeral existence; this has created a prejudice which operates against every new institution, and which tends to damp the courage of those who are not steeled against disappointments. With many persons, so prejudiced, the committee came into contact, and a doubt of the practicability of the plan having been started, it was suggested as a means of insuring its success, to

abandon the hope of forming a new society, but to endeavour to engraft the views of the committee upon a respectable institution, already in full operation in this city, and which was supposed to have a considerable fund at its disposal, exceeding its present means of employing it. Unwilling to risk the great objects which they all had at heart, by too pertinacious an adherence to their original plan, the committee entered into a negotiation which was protracted throughout the winter, and which eventually failed. It was at last, found that no assistance could be expected from the old institution, many of whose members entertained serious doubts as to the legality, or even expediency, of any measures tending to change their accustomed objects of support. In the mean while, procrastination was attended as usual with languor—several of the members dispersed—the winter, which is the best season for active exertions of this kind, having been allowed to pass away, the plan was finally dropped. We deem it, however, fair to state, that from peculiar circumstances, the committee had not been able to confer with many of the practical men of our city; from the spirit which they subsequently manifested, no doubt can exist that they would at that time have extended their support to the proposed institution, as readily as they have since done.

The plan having been abandoned by the projectors of 1822, it appears that a similar one was devised by a number of gentlemen entirely unconnected with the former. After sundry unsuccessful attempts to form a meeting for this purpose, a small one was held at the Hall of the American Philosophical Society on the 9th day of December, 1823. The minutes of this meeting, which was considered as the first of the Institution, under whose patronage this Journal is now issued, do not inform us how many persons were present at that time, but we have been told upon good authority, that there were not more than five. From this small beginning, then, did the Franklin Institute arise. A coalition had by this time taken place between the projectors of 1822 and those of 1823; and these, together with many others, who had promised their aid and support, soon satisfied the few members present, that their forces would be multiplied a hundred fold, as soon as their plan should be fairly before the public.

At the meeting of the 9th of December 1823, a committee of seven gentlemen was appointed to prepare the draft of a constitution, and such other papers as might be necessary to lay before an adjourned meeting, to be held at such time as they might appoint, and to which they were authorized to invite such persons as they might deem friendly to the scheme.

This committee held several meetings, and after having adopted the best measures which, with the assistance of their friends, they could devise, for the establishment of the institution, it became a subject of serious consideration with them, in what manner the plan should be brought openly before the public. Two different methods have been chiefly resorted to in this city in similar undertakings; the first consists in digesting the matter at small private meetings,

adopting a constitution, selecting the first board of officers, and then endeavouring to enlarge the society by the exertions of the framers, and of the board. The second plan is to bring the matter immediately before a public meeting, and to entrust to that meeting the initiatory steps, as well as the subsequent success of the scheme. Both these methods have their advocates, and are supported by plausible reasons. The latter course, is unquestionably the most open and candid, and if nothing interfere to distract the meeting, it is that most likely to prove successful in the end. But those who are conversant with public meetings, know that frequently the efforts of the real friends to a measure of public good, are frustrated by insidious attempts from persons whose sole design seems to be to thwart every thing that they have not themselves devised, or that leads not to their personal aggrandizement. Notwithstanding these objections, the full force of which was felt by the members of the committee, they unanimously resolved to risk this attempt. The failure produced in the preceding year by the lukewarmness resulting from delays, convinced them that it was only by striking a decisive blow, that the popularity of the object could be tested. Being vested with the power to convene an adjourned meeting, and to invite to it as many persons as they pleased, they resolved upon extending the invitation to all the inhabitants of the city and county, friendly to the promotion of the arts, and accordingly called a town-meeting for Thursday the 5th of February, 1824, at the County Court House: in order to insure a general attendance, they issued a large number of circulars, and addressed one to every person whose name was suggested to them as likely to benefit the cause. The meeting was a very large one, and it was evidently formed of the very persons whose attendance was chiefly desirable. The circumstances under which they were convened, the views of the committee in extending the invitation to all the citizens of the county, and in laying the matter fairly and publicly before them, prior to the adoption of the Constitution, or to the selection of the officers, were fully stated to the meeting.

A number of resolutions which had been prepared by the committee, were presented and severally adopted, after a discussion which showed the disposition of the meeting to act advisedly upon the subject. The draft of a constitution was then submitted, and after various amendments, the usefulness of many of which has since been fully tested by experience, the several articles were separately adopted, and after having passed several resolutions relative to the first election for officers, which was ordered to take place on the 16th of the same month, the meeting adjourned.

[TO BE CONTINUED.]

Society for promotion of Internal Improvements.

In the last number of the Journal, we proposed to furnish in this, an abstract of the Instructions given to Mr. Strickland, by

the Society for the promotion of Internal Improvements. We have since determined to publish the paper entire. Our readers will thus be able to form some estimation of the value of the materials contained in this gentleman's reports, which the Society is about to publish. A work which, for practical utility upon the subjects which it embraces, will be found to be without an archetype in any language.

Mr. Strickland's Instructions.

Philadelphia, March 18, 1825.

WILLIAM STRICKLAND, Esq.

Dear Sir—The Acting Committee of "The Pennsylvania Society for the Promotion of Internal Improvements," beg leave to call your attention to the general outlines of the duties you will have to perform, as the agent of the Society in Europe.

The objects, for the attainment of which the Society have determined upon this measure, the execution of which is delegated to you, are known to you, and you will constantly have in view their accomplishment with your best abilities. The confidence we place in your talents and industry, the obligations you will be under to obtain, for the heavy expenses attendant on your agency, an adequate return; and the satisfaction, as well as the rewards you will yourself have in contributing, by the success of your labours, to the prosperity, wealth, and happiness of your native state, and of your country, are ample pledges of the fidelity and diligence with which you will execute the duties of the important trust.

You will proceed from this city to Liverpool, taking your passage in one of the line of packets from this port, and commencing your voyage within the present month.

As *England, Scotland, Wales,* and *Ireland,* have made more progress in the arts and sciences, and have more extensively and successfully applied them to internal improvements, your observations, inquiries, and investigations will, in the first portion of the time you will be absent, be directed to the great works which have been accomplished in those countries. You will afterwards proceed to *France, Holland,* and *Germany,* should any objects of sufficient interest exist there, and time shall permit the same. Thus we desire it to be distinctly understood, that you will visit no other parts of Europe, unless further instructed, than England, Scotland, Wales, Ireland, France, Holland, and Germany.

As a general principle which shall govern you in all your proceedings, and as the leading purpose in all your pursuits, we wish you to understand, distinctly, that all the knowledge and information you can collect, all the facts which you shall become possessed of, which may in any manner be connected with your mission, must be carefully, accurately, and minutely written down and preserved in the form of a diary, or such other record as will enable you to communicate the same to the Society, in memoirs or reports, when your duties shall enjoin the same. All the results of your inquiries and exertions will be the property of the Society.

Another and equally important rule, which we wish you to observe and faithfully execute, is the following.

It is not a knowledge of abstract principles, nor an indefinite and general account of their application to the great works of Europe, we desire to possess through your labours. These we have in books, and your mission would be of little comparative value, should you acquire for the Society such information only. What we earnestly wish to obtain, is the means of executing all those works in the best manner, and with the greatest economy and certainty; and for these purposes you will procure and exhibit in your reports, all that will enable those who shall undertake the formation of *Canals, Railways*, and *Roads*, and the construction of *Bridges*, to perform the work, without such persons having the science by which such works were originally planned and executed. To use a term which is familiar to you as an architect, we desire to obtain *working plans* of the best constructed canals, and their locks and inclined planes; of railways, and all the means of using them to advantage; of *roads*, and of the mode of their formation and preservation; and of the construction of *bridges*. To be more definite on this head, we desire that you furnish such minute and particular descriptions, plans, drawings, sections, estimates and directions, as possessed of them, those works may be executed in Pennsylvania, without the superintendence of a civil engineer of superior skill and science.

Before we proceed to a particular statement of the subjects for your investigations on your mission, we would claim your attention to a pledge which has been given by the Society to the public; that your first efforts shall be directed to *railways*, and that at as early a period as possible, you shall communicate all the information you can collect upon them.

Canals. In your examination of the canals of Europe, we request you will always bear in mind the fact, that the great capital which is ever at the command of those who there undertake such works, and the immediate and profitable use to which they can be applied, have induced those who have executed them, to regard their cost of less importance than we are compelled to consider it here. When a work of that kind will produce returns of three or four times the rate of interest in the country where it is executed, expenditure is of less consequence than with us, where the pecuniary means to accomplish any such purposes are collected with great difficulty, and where attempts to execute them frequently fail from a want of capital. Whatever may be the certainty of ultimate profit from any of our canals or roads, we have always found obstacles to obtaining funds for their prompt execution. In the differences between the cost of labour in England and Scotland, and in America; the cheapness of some of the materials used in the construction of their public works, and in the facilities of transporting those materials which the improved state of the country, and the existence of canals and railways in the vicinity afford, may be found many important facts which have materially influ-

enced the cost of those works; on the other hand, we have materials, which may not have been used there on account of their scarcity and expense, and which if substituted in our undertakings, would materially diminish our expenditures in the formation of canals, with their locks, and inclined planes. Thus *wood* is in England a most costly article, and hence stone is there generally substituted. If wood could be used in the construction of the *locks* of canals, more than two-thirds of their expense would be saved, and the execution of many works of this description, in our country, would be certain.

With these introductory remarks, which are submitted to your candid consideration, we proceed to say, that you will, in reference to *canals*, inquire and report to the Society upon, 1st. The most approved and substantial method of constructing *Lock Gates*, together with their *valves* and sluices.

2nd. The best mode of lining and *puddling Aqueducts and Culverts.*

3d. The best plan for overcoming the difficulty in forming the bottom and side banks of a canal, through limestone formations; or formations which are cavernous, porous, or soluble in water; particularly in deep cutting, and in embanking.

4th. The cost of the work by the cubic yard, stating the particular quality and parts thereof.

5th. The failures in canals; their causes; and other circumstances connected therewith.

6th. Rock excavation; tunnelling generally, and through *gravel and other loose soil;* the use and frequency of *shafts;* together with the best method of removing the materials, and draining the work in its progress: the greatest depth of shafts, and how preserved and constructed?

7th. The quantum of *evaporation* and *soakage*, particularly considered; reference being made to the *locations*, *soil*, and *quality* of the work.

We also request your attention to the following queries, which relate to canals, or subjects connected with their use.

8th. Is there any substitute for locks, now in use in England, or on the continent? If so, what advantages have they been found to possess?

9th. Is there any information in England concerning the evaporation of water occasioned in canals by variations of climate? The great mining districts of Germany, furnish some very curious results as to the evaporation by high winds in the autumn and winter season.

Perhaps the canals of the south of France may afford some facts on the solar evaporation, in summer. Our climate is so different from that of England, that we must endeavour to obtain *data* on this subject from the continent.

10th. Are steam boats permitted to navigate any of the canals in Great Britain? If any, what means have been devised to prevent the destruction of the banks, produced by the motion imparted to the water?

11th. Are any of the tunnels in England made through crumbling rocks? if so, what arch is preferred for their protection? is there any case where a complete elipsis has been required, as in mines?

12th. If a rock is not to be obtained for a foundation for the lock walls, do they in every instance pile, or construct inverted arches, upon which to build their walls; or do they, when they have good gravel or slate, rely upon it for a foundation? If not, may not timber laid lengthways be relied on? When they have not rock for the bottom of their locks, do they make an artificial bottom of stone or wood?

13th. Do they build their lock walls in straight or curvilinear lines? What is the thickness of their lock walls, and are they supported by buttresses extending into the banks? or by giving the walls a greater thickness, do they supersede the necessity for buttresses? How are their lock walls built—if of cut stone in front, how is the backing constructed—whether of common rough mason work, or of large stone well fitted together? What is the best kind of cement, and how is it affected by the seasons? How soon does it perish?

14th. What is the slope of the banks of a canal? What the height of the banks above the surface of the water, particularly the towing path side, and its width?

15th. In very deep shafts, are the workmen affected by the gases from the bowels of the earth? Is there an instance of the workmen being driven off by the gases? What proportion does the diameter of the shafts, bear to their depth? What distance are shafts apart, and is not this regulated by the depth of digging, or height of the hill? What is the greatest depth a shaft may be sunk?

16th. What kind of river navigation have they above the tide? How is the navigation constructed? What kind of towing paths have they? What distance are they from the boat channel; and when the distance between them is very great, is the power for propelling the boat necessarily very much increased? If so, is it in direct proportion to the distance?

17th. What kind of gates have they across the towing paths, where they pass through different enclosures?

18th. In the severe weather in the winter, do they draw the water off their canals?

19th. Have the frosts of winter any pernicious effect upon their canals, locks, turnpikes, and rail-roads?

20th. What descent have their canals, or what is the approved descent? What is the greatest acclivity of rail-roads?

Mr. John Blair, of our state, whose communications to the Society have always been valuable, has expressed a wish that you should inquire, whether wooden locks are in use, what length of time they will last, and what is the comparative expense between them and stone locks? He remarks, and justly, that as our western canals must have the greatest portion of their lockage in, and near the

mountains, where there are inexhaustible forests of timber, should timber be useful, and the durability of such locks considerable, a great saving would be effected. This subject is placed in a very interesting position by a letter of Mr. Sellers, which we request you will peruse. Like the early settlements of our country, we may find it advantageous to be simple and homely in our first works, and in time, replace them by others of a superior execution, and of permanent materials.

Railways.—Of the utility of railways, and their importance as means of transporting *large burdens*, we have full knowledge. Of the *mode* of constructing them, and of their cost; nothing is known with certainty. Even in England, where *railways* have been used for more than a century, these are subjects of controversy and doubt. You will arrive at Liverpool at a peculiarly fortunate era in the construction and employment of railways. The great communication by their means, between Manchester and Liverpool, and between Birmingham and Liverpool, will have been commenced; or all the principles and plans, by which they will be governed in their construction, will have been settled and determined.

We desire that your inquiries in relation to *railways* shall be commenced and prosecuted as soon as you arrive; and that as speedily as you shall have obtained all the information upon them you deem important and sufficient, that you transmit the same to us; retaining a duplicate of your report, and of the drawings and estimates which may accompany it for illustration.

You will bear in mind, in your investigations of this subject, that we have, as yet, no complete railway in Pennsylvania; and you will therefore so exhibit your facts, as that they may be understood by reference to the drawings which you may make, and which shall accompany your report.

Commencing in your examinations with the plans observed in making surveys and forming the line of the route of the railway; it is desired that you ascertain with precision the greatest angles of ascent which the profitable use of railways will bear. In our mountainous state, if railways shall be adopted, they must pass over numerous elevations, some of them abrupt, and many of them so formed as to render their reduction impossible.

The *foundations* for the reception of the iron rail will next require attention. Climate must enter materially into the decision upon the question, how the foundation of a railway shall be made in Pennsylvania; and the differences between the moist and moderate winters of England, and the deep snows, sudden and hard frosts, variable temperature, and long continuance of our winters, must have your consideration and attention in these examinations. Without entering into the subject particularly, but submitting it, with great deference, to your consideration, we would remark, that if masonry could be avoided in the construction of the foundation for the iron rails; if wood, however large in size, and great in quantity can be employed here, the influence of our climate upon the

work would be less injurious. Durability of the materials would be lost by the use of wood, but the parts might retain their form and connexion for a long time, and the small expense of replacing any part of the work which might decay, would perhaps compensate for the absence of permanent substances in the foundation. In relation to the construction and form of the road and rails, we desire you to ascertain every mode which is now in favourable use in England, Scotland, and Wales. It is said that recent improvements have been made in the form and position of the rails; and that different forms are used for different purposes. How railways are crossed by wagons heavily laden, how wagons pass when proceeding in opposite directions, what means are taken for the protection of railways from injury by wheels not properly constructed to pass upon them, and how the wagons and their carriages are constructed, and of what materials? Upon all these subjects we ask particular information, accompanied with drawings which will make the same easily understood and employed.

The *expense* of railways will be a subject of careful and particular investigation. In your statements under this head you will inform us of the separate cost of each part; distinguishing accurately between the charges for the formation of the line, and the preparation of the foundation, and the expense of the materials employed. The difference between the cost of labour in England and in this country, will affect these statements; and it would therefore be well, if you would accompany your report with information of the rates of day labour, in the particular parts of the country where the railways are located, which may be referred to by you.

Locomotive machinery will command your attention and inquiry. This is entirely unknown in the United States, and we authorize you to procure a model of the most approved locomotive machine, at the expense of the Society.

[TO BE CONCLUDED IN OUR NEXT.]

FROM THE LONDON TIMES.

PERKINS' STEAM GUN.

The neighbourhood of Mr. Perkins' safety steam engine manufactory near the Regent's Park, was on Tuesday thrown into great consternation by some tremendous reports, arising from the discharge of his steam gun. Since a fatal accident, which occurred several months ago, where a lady threw herself from a gig, in consequence, as it was at the time incorrectly supposed, of her horse having taken fright at the prodigious noise made by the steam gun, the terrific engine of destruction had not been permitted to be discharged by the individuals belonging to Mr. Perkins' concern. On Tuesday morning, however, soon after eight o'clock, patroles were observed stationed on all the roads leading towards the manufactory, accompanied by men with placards on boards, warning all

passengers on horseback or in carriages, to go through the Regent's Park, instead of proceeding by the high road leading in front of the manufactory.—Soon after nine, numbers of military officers, in carriages and on horseback, alighted at the manufactory. They were soon followed by the Duke of Wellington; and immediately afterwards the discharge of steam, which had been previously occasional, and of comparatively slight force, commenced with a continued roar, resembling the loudest thunder we ever heard. The group of eminent persons then assembled, consisted of his Grace, the Master General of the Ordnance, and his Staff, the Marquis of Salisbury, Mr. Peel, Sir H. Hardinge, Lord Fitzroy Somerset, the Judge Advocate General, and many military officers of the highest rank; together with a Committee of Artillery and Engineer Officers, who, it appeared, had been officially appointed by the Duke of Wellington to examine into the merits of this wonderful specimen of human ingenuity and destructive power. The discharge of steam now became almost incessant for two hours; during which, its incalculable force and astonishing rapidity in discharging balls, excited amazement and admiration in all present. At first the balls were discharged at short intervals, in imitation of artillery, firing against an iron target at the distance of 35 yards. Such was the force with which they were driven, that they were completely shattered to atoms. In the next experiment, the balls were discharged at a frame of wood, and they actually passed through 11 one inch planks of the hardest deal, placed at a distance of an inch from each other. Afterwards they were propelled against an iron plate one fourth of an inch thick, and at the very first trial, the ball passed through it. On all hands, this was declared to be the utmost effort of force that gunpowder could exert. Indeed, we understand that this plate had been brought especially from Woolwich, for the purpose of ascertaining the comparative force of steam and gunpowder. The pressure of steam employed to effect this wonderful force, we learnt, on inquiry, did not at first exceed 65 atmospheres, or 900lbs. to the square inch; and it was repeatedly stated by Mr. Perkins, that the pressure might be carried even to 200 atmospheres with perfect safety. Mr. Perkins then proceeded to demonstrate the rapidity with which musket balls might be projected by its agency. To effect this he screwed on to the gun barrel, a tube filled with balls, which, falling down by their own gravity into the barrel, were projected, one by one, with such extraordinary velocity, as to demonstrate, that by means of a succession of tubes filled with balls, fixed in a wheel, (a model of which was exhibited,) nearly one thousand balls per minute might be discharged. In subsequent discharges or volleys, the barrel, to which is attached a moveable joint, was given a lateral direction, and the balls perforated a plank nearly twelve feet in length. Thus, if opposed to a regiment in line, the steam gun might be made to act from one of its extremities to the other. A similar plank was afterwards placed in a perpendicular position, and in like manner, there was a stream of shot holes from the top to the bottom. It is thus proved

that the steam gun has not only the force of gunpowder, but also admits of any direction being given to it. But what seemed to create most surprise, was the effects of a volley of balls discharged against the brick wall by the side of the target. They absolutely dug a hole of considerable dimensions in the wall, and penetrated almost one half through its thickness. We heard several officers declare their belief, that, had the balls been made of iron instead of lead, they would have actually made a breach through it—the wall was 19 inches thick.

ON IRON AND STEEL. BY THOMAS GILL.—No. 2.

On hardening and tempering cast steel.

Various compositions are used for this purpose, according to the nature of the articles to be hardened and tempered. For saws of the usual description, and springs in general, the following is an excellent hardening and tempering liquid; viz.

Twenty gallons of spermaceti oil;
Twenty pounds of beef-suet, rendered;
One gallon of neat's-foot oil;
One pound of pitch;
Three pounds of black resin.

These two last articles must be previously melted together, and then added to the other ingredients; when the whole must be heated in a proper iron vessel, with a close cover fitted to it, until all the moisture is entirely evaporated, and the composition will take fire, on a flaming body being presented to its surface; but which must be instantly extinguished again, by putting on the cover of the vessel.

The cast steel articles, if *thin* or *slender*, may be quenched in this composition, in order to harden them; and then be blazed off, as the operation is termed, over a clear fire, in order to temper them. If the articles are *thick*, such as sword-blades, &c. they should be previously hardened, by quenching them in rain-water: and then be tempered, by wiping them over, on both sides, with a thin coating of the tempering liquid, applied by means of a round hard brush, and then blazed off.

On making cast steel exceedingly hard.

By the following process, cast steel may be made exceedingly hard: and we have reason to believe that the celebrated files made by RAOULE of Paris, which will act upon or abrade most of the English files, owe their hardness to a similar operation. We know, also, that thin back-saws, or slit-saws, awls, and cock-heels, of an extraordinary degree of hardness, are so made.—The following is the hardening liquor:

Two pounds of mutton-suet, *not rendered*, but only chopped small;
Two pounds of hog's-lard;
Two ounces of white arsenic, powdered.

These, being put into an iron vessel, with a cover fitted to it, must be boiled, until a handful of *Mouse-ear*,* fresh gathered, and which had been put into the mixture at first, shall become crisp, and float on the surface of the liquor;—a proof that all moisture is driven off. This operation, as well as that of quenching any article in it, in order to harden it, must be performed under the hood of a smith's forge-hearth, so as to carry off as much as possible the noxious arsenical fumes which arise; and the operator ought also to cover his mouth and nostrils, to prevent his inhaling them. In using this compound, it must be previously melted: and in order not to overheat the thin or small articles to be hardened, it is well to heat them upon a bar of iron previously made red-hot, and, when of a due temperature, to drop them into the liquor. The work-shop will, in spite of these precautions, become more or less filled with dense arsenical fumes;—a proof that much of the arsenic must have been dissolved in the hardening liquor; and some of it, no doubt, enters into union with the steel quenched in it, so as to produce such an extraordinary degree of hardness therein.

The instructions already given, for selecting the *hardest* cast steel, of which these articles are to be made, must be particularly attended to; and the greatest care must also be taken in avoiding all excess of heat in forging and hardening them, in order to ensure the good effects of the process.

On setting steel articles straight which have warped in hardening.

This must be done whilst the articles are as hot as their tempering heat will permit: and is effected, either by means of two strong iron forks, one fixed securely in an anvil block, and the other in a handle, in order to get out warps or twists sideways; or by smart blows with a hammer on the hollow side, the other side resting on an anvil previously strewed over with sand, to prevent the article from slipping away, to get out bends in it: or, otherwise, if the article be slender, such as a file, graver, &c. it may be done by brightening the concave side, and heating it, by pressing it with another proper tool, upon the convex surface of a red-hot iron heater, securely held in a bench-vice, the article being held by one end in the tongs or hand-vices; when it will easily yield to the force impressed upon it when heated; and it may be seen, by the colour it has assumed on the brightened surface, when it has nearly attained its tempering heat. Slender files may be previously dipped into a mixture of olive-oil and spirits of turpentine, and may be safely heated as above, till the mixture begins to smoke. Sword-blades, and other articles in the *ground* state, may be heated to nearly a blue colour, over a cinder fire; and, whilst hot, be struck on a soft anvil, with a hammer made of tin, to avoid bruising them: and if *glazed* also, the blue colour may be removed, by a weak mixture of muriatic acid and water being wiped over them, without staining them much, the acid acting only on the oxided surface.

* *Hieracium Pilosella.*—See Curtis's Flora Londinensis, 53, Fas. 3.

NOTE BY THE EDITOR.—The practice of blazing off, mentioned in the preceding article, is known to most of our workmen; the object generally, is to reduce hardened steel to a spring temper; to effect this, it is covered with oil, tallow, or some other combustible, which when warm will flow over every part; the steel is then held over the fire, moving it so as to heat it regularly, until the grease flames and burns off. It must be evident that it is by no means a matter of indifference, what oily, fat, or resinous substance is used; when a high spring temper is required, this will be obtained by such as burn the most readily, whilst those which require a higher degree of heat for their combustion, will reduce the temper in a proportionate degree. Both the nature of the steel, and the degree of reduction of temper required, ought to be taken into the account.

There is another mode of giving the spring temper, without the use of grease, and without brightening to observe the colour. The spring is hardened in the usual way, and then held over the fire; a small piece of wood is occasionally rubbed over it, which will exhibit sparks of fire, when the steel is sufficiently heated; a good spring temper may be thus obtained; and this also may be varied, by using soft or harder wood, such as pine, oak, &c.

There are many other plants besides the *mouse-ear*, which will answer equally well; as its only use is to show that all the moisture has evaporated from the mixture.

Where it is wished to remove the blue colour from a sword, or any other article, a very weak solution of sulphuric acid, (oil of vitriol) or even good vinegar will answer the purpose.

Workmen are sometimes fearful of heating their steel to blue it a second time, apprehending that by so doing they may injure the instrument; but of this there is no danger; the blue colour may be taken off and restored any number of times, without producing this effect. When an article is tempered by bringing it to a particular colour, and it is found to be too hard, it will not be in the slightest degree reduced by brightening and bringing it again to the same colour, however frequently it may be repeated; it must in all cases be brought to a shade which indicates a lower temper.

On Improving the quality of Saws, by hammer-hardening their Teeth.

The Editor lately mentioning to Mr. Christie, the worthy Secretary of the London Mechanics' Institution, Mr. Turrel's great improvement in gravers, effected by hammer-hardening them, it occurred to him, that the practice, frequently adopted by smiths, and other workmen, of hammering the worn and blunted tops of the teeth of their back and frame-saws, merely with a view of spreading them sideways, so as to free themselves in use, previous to filing them sharp again, must not only have that effect, but must likewise greatly conduce to the improvement of their *hardness* and *toughness*, from the *condensing effect* of the hammer upon them.

Mr. J. I. Hawkins, on being informed of this, by the Editor, perfectly agreed in this opinion of Mr. Christie's; but, with his usual acuteness, suggested the farther improvement of first filing the teeth into shape, and then finishing them *by hammer-hardening their tops;* which would not only spread them out sideways, but would also preserve to them all the advantages of the effect of the hammer upon them; which, according to the present practice of filing them after hammering them, are in a great measure lost; and he thought there would be little difficulty in applying his improvement to the teeth of all saws, which were not exceedingly small. He would screw the saw fast in a vice, (the teeth in the chaps of which were guarded from indenting the saw, by plates of copper lining the chaps on each side) and, with the flat cross-pane of a hammer, the handle of which was held towards the fore part of the saw, and the hammer itself at a proper angle to suit the form of the teeth, he would then hammer-harden every individual tooth.*

The best saws are those which have been considerably condensed by hammer-hardening them on their sides, in making them; but this additional process, of hammering the tops of their teeth, cannot but prove a considerable improvement upon them.

[*Technical Repository.*

On the great improvement made in Bricklayer's Trowels, by hammer-hardening them. By Mr. GEORGE WALBY.

There is, perhaps, no implement which undergoes more severe treatment than the bricklayer's trowel does, in its constant employment of hacking bricks into shape, and thus encountering the pieces of flint, pebbles, &c. ordinarily mixed with the clay; and which, besides having a tendency to injure its edges, also render it liable to break continually. Mr. Walby, therefore, by his excellent processes, accomplished a most difficult task, and rendered his superior trowels highly prized, by those persons who were the most competent judges of their merit, from their constant experience in their use; and, indeed, his brick-trowels, like the hand-saws made by the Editor's late father, were continually changed by grinding, into other and smaller kinds, until they became too diminutive for any useful purpose; their originally excellent quality remaining perfect to the last.

They were made of the best shear-steel, carefully worked throughout, and especially avoiding to over-heat the steel; and towards their finishing in the plating or forging, and when nearly reduced to their proper thickness, besides heating them in a clean hollow-fire, to avoid contact with cinders, &c. he also removed all scales upon their surface, by means of a very ingenious revolving elastic steel brush of his invention, previous to giving them their last planishing, under the rapid blows of a hammer driven by a steam-engine. He carefully attended to the proper hardening heat, and

* A punch would answer the purpose better.—EDITOR.

quenched them in a composition or hardening liquor, similar to those used by saw-makers; he next blazed them off to the spring temper; and, lastly, *hammer-hardened them as much as possible.* They were then ready for grinding, after which operation, their elasticity being again restored, by blueing them, they were glazed or brightened, ready to be mounted into their handles.

We have many particulars of the various tools used by Mr. Walby in his practice of trowel making, and which are well deserving of being published.

On the improvement of Drills, by hammer-hardening them cold.

Mr. Andrew Pritchard, the inventor of the hard shel-lac cement, finding that steel, when hardened and tempered, is susceptible of receiving the condensing effect of the hammer, has applied it with considerable advantage, to the points of small drills, by hammering them upon their flat surfaces.

On the employment of Cast-Steel Plates, for Engravers, in their Carbonated state.

We are glad to find that cast-steel plates are now beginning to be employed by some of our first rate artists, without having undergone the process of *decarbonating* them as usual. Their advantages are eminent, not only in the greater facility of etching cast-steel than iron, but chiefly in the increased number of impressions they will afford.

Here Mr. Turrell's improvement on the graver is invaluable; and indeed, previous to his informing his brother artists of his method of condensing their edges, by hammer-hardening them, the difficulties they had to encounter were nearly insurmountable.—[*ib.*

On Improving the edges of Penknives, by Burnishing them.

The Editor, following his old habit, of reasoning from analogy, thought, that as the advantages of burnishing the edges of currier's shaving-knives, cabinet-maker's steel-scrapers, and the turning tools for brass, were so manifest, in giving additional strength, toughness, and smoothness to their edges; so the application of it to the edge of a penknife, might likewise prove advantageous; and accordingly, having first carefully whetted the blade of his penknife, (which is one of the ordinary quality,) upon a Water of Ayr stone, with water, he finished it by a gentle and delicate stroke of the cylindrical part of the currier's burnisher, carried along its edge, so as to throw it forward a little from the back, or convex side of it, towards the concave side; and which he found to have effected a great improvement indeed, in its cutting qualities; it now seizing the quill, as it were, in making or mending a pen, and making a smooth polished cut, such as he was never able to effect by it previous to this application of the burnisher; and the edge has endured in use for a considerable time, in mending a number of the portable pens, laid out for that purpose; so that he can safe-

ly recommend it as a considerable improvement, on the edge of that useful and necessary instrument, the pen-knife.—[*ib.*

CAOUTCHOUC TUBES.

In page 61 of this Journal, we have given Mr. Leeson's method of making tubes of Indian rubber; in this paper a reference is made to his mode of distending the gum-elastic bottles, for constructing his *self-acting blow-pipe*, which will be found in the next article.

The forming of such tubes, by cutting the material into strips, and causing them to adhere by the aid of heat and pressure, has been long known, although it has been but little practiced; owing probably to the difficulty of cutting the strips with neatness and uniformity; a difficulty which is obviated by Mr. Leeson's method of distension.

Where tubes of considerable length are wanted, the method of making them, described by Mr. Thomas Skidmore in the 5th volume of Silliman's Journal, is undoubtedly to be preferred; as a long tube in contact with a rod of metal, or if glass, would adhere so firmly, as to render its removal impossible. Mr. Skidmore takes a cylindrical rod of iron of the desired length, round this he closely coils annealed wire, in the manner of a spiral spring; care being taken that the edges of the coiled wire shall touch each other, but shall at the same time not be so firmly wound, as to prevent its being slipped off the rod. The spiral wire is then covered with tape, coiled from end to end, and upon it are laid the strips of Indian rubber, wound in a similar manner, with their fresh cut and clean edges lapping upon each other; these are to be very firmly pressed together by another coil of linen tape; the rod is then withdrawn, the tube is boiled in water for an hour or two; and when cooled, the wire and tapes are to be removed. If the process has been properly managed, the tube, although rough, will be perfectly sound in every part.

When the purpose to which the tube is to be applied renders it desirable that it should not collapse, the inner tape may be omitted, and the caoutchouc wound immediately upon the wire, which in this case need not be annealed. For most purposes brass would be preferred to iron, as being less liable to corrosion from moisture.

When cut thin, or when extended, this subtance forms excellent washers, or collars for stop cocks; a very little pressure being sufficient to render them perfectly tight. Leather has also been coated with caoutchouc, and without being adhesive, is perfectly water tight, and free from odour.

SELF-ACTING BLOW-PIPE.

It is pretty generally known, that bottles of Indian rubber may be expanded to a considerable size, by condensing air into them;

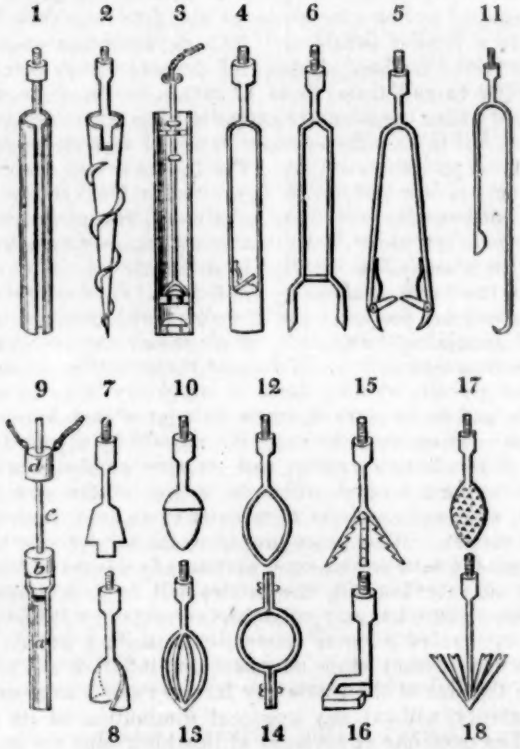
but Mr. H. B. Leeson is the first who has applied bottles so filled to the purposes of a blow-pipe. The bottles he makes use of, vary in weight from a half to three-quarters of a pound, and may be readily procured at any stationer's.

"To prepare them they should be boiled in water till completely softened; which, if they are put into water already boiling, will generally be accomplished in ten minutes or a quarter of an hour. They must then be taken out and suffered to cool, when a brass tube may be fitted into the neck of the bottle; having a small cork screwed into it at one end, by which it may be connected with the condensing syringe, and to which the blow-pipe jets may be attached. There should be a milled projection on the side of the tube for the purpose of more firmly attaching the bottle to it, which may be effected by passing a ligature of waxed string round the neck of the bottle on each side of the above mentioned projection. The bottle must next be filled with condensed air. After a few strokes of the syringe, a blister will be observed to form, which will gradually enlarge till the greatest part of the bottle (which must be selected uniform in substance and free from defects) has extended to a similar substance. The condensation should not then be continued farther. Bottles of the size I have mentioned, will generally extend from 14 to 17 inches in diameter without bursting, and I have occasionally extended them much beyond these dimensions; but in this the operator must, of course, be entirely directed by his own observations. The Indian rubber varies in its quality: there is one sort which appears of a blacker hue before extension, but becomes very thin and almost transparent on condensing air into it; whilst there is another sort having a browner colour, which is much less yielding in its substance, and cannot be extended to the same thinness as the former. I have found both sorts to answer my purpose; but the above observations may be useful in determining the quantity of air which may be condensed into the bottles with safety. To apply these bottles when filled with condensed air, nothing more is necessary than to remove the syringe, and in its place to screw on a jet of such bore as may be required. On opening the cock, the air will be expelled by the elasticity of the Indian rubber, and its own condensation, in a strong and uniform stream, which, in bottles of the size I have mentioned, will continue from 25 minutes to an hour, according to the size of the jet. When once prepared, the bottles may be constantly expanded to the same size, without any danger of bursting. When the air is exhausted, the bottles will be found somewhat larger in dimensions, but may again be contracted by holding them before a fire, or a few minutes' immersion in boiling water. This, however, is unnecessary, since no subsequent inflation will be found to increase the size of the bottle any further; and I have used the same repeatedly, without any apparent diminution of its elastic powers. The principle advantages of this blow-pipe are its great portability, and length and steadiness of action, (in which I consider it much superior to the hydraulic blow-pipe) together with the

perfect liberty at which, when properly mounted, it leaves the operator's hands. This blow-pipe is applicable to any of the gases, and may, I conceive, be applied with advantage to contain the explosive mixture of oxygen and hydrogen, as no inconvenience can possibly accrue from its bursting, beyond the loss of the bottle. This blow-pipe may be supplied with air or gas during an experiment, by having a separate communication for the syringe into the piece of tube before mentioned, and this will enable the operator to continue his experiments for any period of time.—[*Quarterly Journal of Science.*

ENGLISH PATENTS.

To JOHN GOOD, *of Tottenham, in the County of Middlesex, Engineer, for his invention of certain improvements in Machinery, tools, or apparatus for boring the earth, for the purpose of obtaining and raising water.*



In our last number, page 24, we gave a particular account of the novel and important practice of boring the earth for water, by

which means springs are discovered, and water raised from a considerable depth, at a very trifling expense compared to the ordinary process of well-digging.

The present patentee has been extensively employed in this business of boring the earth for water; and the implements which form the subject of this patent are such, as in addition to those we have before described, are found to be necessary or useful under different circumstances in the progress of that business; our readers will therefore perceive the advantage of these improved implements in a more forcible way, by first running over the previous account (which we have given with considerable exactness,) of the whole of the process of boring, and the tools then employed.

The cut, exhibits the newly invented implements; fig. 1 is an auger, to be connected by the screw-head to the length of rods by which the boring is carried on. This auger is for boring in soft clay or sand; it is cylindrical, and has a slit or opening from end to end, and a bit or cutting-piece at bottom. When the earth is loose or wet, an auger of the same form is to be employed, but with the slit or opening reduced in width, or even without a slit or opening. A similar auger is used for cutting through chalk, but the point or bit at bottom should then project lower, and for that purpose some of these cylindrical augers are made with moveable bits, to be attached by screws, which is extremely desirable in grinding them to cutting edges. Fig. 2 is a hollow conical auger for boring loose sandy soils; it has a spiral cutting edge coiled round it, which, as it turns, causes the loose soil to ascend up the inclined plane and deposit itself in the hollow within. Fig. 3 is a hollow cylinder or tube, shown in section, with a foot valve, and a bucket to be raised by a rod and cord attached at top; this is a pumping tool for the purpose of getting up water and sand that would not rise by the auger. When this cylinder is lowered to the bottom of the bore, the bucket is lifted up by the rod and cord, and descends again by its own gravity, having a valve in the bucket opening upwards like other lift pumps, which at every stroke raises a quantity of water and sand in the cylinder equal to the stroke, the ascent and descent of the bucket being limited by a guide-piece at the top of the cylinder, and two small nobs upon the rod, which stop against the cross-guide. Fig. 4, is a tool for getting up broken rods, it consists of a small cylindrical piece at bottom, which the broken rod slips through when it is lower, and a small catch with a knife-edge, acted upon by a back-spring. In rising, the tool takes hold of the broken rod, and thereby enables the workmen at top to draw it up. Another tool for the same purpose is shown at fig. 5, which is like a pair of tongs; it is intended to be slidden down the bore, and for the broken rod to pass between the two catches, which pressed by back springs, will, when drawn up, take fast hold of the broken rod.

Fig. 6 is a tool for widening the hole, to be connected, like all the others, to the end of the length of rods passed down the bore; this tool has two cutting-pieces extending on the sides at bottom,

by which, as the tool is turned round in the bore, the earth is peeled away. Fig. 7 is a chisel, or punch, with a projecting piece to be used for penetrating through stone; this chisel is by rising and falling made to peck the stone and pulverize it; the small middle part breaking it away first, and afterwards the broad part coming into action. Fig. 8 is another chisel, or punching tool, twisted on its cutting edge, which breaks away a greater portion of the stone as it beats against it.

The manner of forcing down lengths of cast iron pipe, after the bore is formed, is shown at fig. 9; *a* is the pipe in the socket, at the end of which a block *b*, is inserted, and from this block a rod *c*, extends upwards, upon which a weight *d*, slides. To the weight *d*, cords are attached, reaching to the top of the bore, where the workmen alternately raises the weight and lets it fall, which by striking upon the block *b*, beats down the pipe by a succession of strokes; and when one length of pipe has by these means been forced down, another length is introduced into the socket of the former. Another tool for the same purpose is shown at fig. 10, which is formed like an acorn, the raised part of the acorn strikes against the edge of the pipe, and by that means it is forced down the bore. When it happens that an auger breaks in the hole, a tool similar to that shown at fig. 11 is introduced; on one side of this tool a curved piece is attached, for the purpose of a guide to conduct it past the cylindrical auger, and at the end of the other side is a hook, which taking hold of the bottom edge of the auger, enables it to be drawn up.

Wrought iron, copper, tin, and lead pipes, are occasionally used for lining the bore; and as these are subject to bends and bruises, it is necessary to introduce tools for the purpose of straightening their sides. One of these tools is shown at fig. 12, which is a bow, and is to be passed down the inside of the pipe, in order to press out any dents. Another tool for the same purpose is shown at fig. 13, which is a double bow, and may be turned round in the pipe for the purpose of straightening it all the way down. Fig. 14 is a pair of clams, for turning the pipe round in the hole while driving.

When loose stones lay at the bottom of the hole, which are too large to be brought up by the cylindrical auger, and cannot be conveniently broken, then it is proposed to introduce a triangular claw, as fig. 15, the internal notches of which take hold of the stone, and as the tool rises brings it up. For raising broken rods a tool like fig. 16 is sometimes employed, which has an angular claw that slips under the shoulder of the rod, and holds it fast while drawing up.

In raising pipes, it is necessary to introduce a tool to the inside of the pipe, by which it will be held fast. Fig. 17 is a pine-apple tool for this purpose, its surface is cut like a rasp, which passes easily down into the pipe, but catches as it is drawn up, and by that means brings the pipe with it. Fig. 18 is a spear for the same purpose, which easily enters the pipe by springing, at the ends of

its prongs there are forks which stick into the metal as it is drawn up, and thereby raise it.

These are the new implements for which the patent is granted; in the process of boring there does not appear to be any thing new proposed, but that these several tools are to be employed for boring, pecking, and otherwise penetrating, raising the earth, and extracting broken or injured tools. There are also suggestions for employing long buckets with valves opening upward in their bottoms, for the purpose of drawing water from these wells, when the water will not flow over the surface; also lift pumps, with a succession of buckets for the same purpose; but as these suggestions possess little, if any novelty, it cannot be intended to claim them as parts of the patent.

To JOHN CHRISTIE, *of Mark Lane, in the City of London, Merchant, and* THOMAS HARPER, *of Tamworth, in the County of Stafford, Merchant, for their Invention of an improved method of combining and applying certain kinds of Fuel.*

This invention is the combination of bituminous coal, with stone-coal, culm, and anthracite, in such proportions as will burn in furnaces and kilns without emitting smoke. The proportions of the materials combined must necessarily depend upon their qualities, and the draft of the fire-place. The quantities of each may be considered generally as varying from one-fifth to one-third bituminous coal, and the remainder stone-coal, culm, or anthracite; the intention of the patentees being to use only so much bituminous coal in the mixture, as may be found necessary to keep up a fire suitable for the various processes to which it may be applied in our manufactories, without giving out smoke.

The inferior kinds of coal, such as stone-coal, culm, and anthracite, when in a state of combustion, give out little or no flame or smoke, though they become heated to redness; it is therefore only necessary to add so much bituminous coal as will stimulate or invigorate the other coal and keep it burning. The patentees have found upon trial, that one quarter of bituminous coal is a good proportion, when the bars of the furnace are one inch wide, and half an inch asunder, there being a good draft. Stone-coal may be employed, or mixed with culm, in the proportions of one half of each, and this mixed as above, and applied to furnaces, will burn without emitting smoke; it is particularly applicable to hot air stoves, and to mix with cinders or brees for the burning of bricks.

NOTE.—The object which the foregoing patent proposes to attain, is one of very great interest, not only to Pennsylvania, but also to various other parts of the United States where anthracite abounds, or to which it can be readily transported. Several of the premiums offered this year by the Franklin Institute, relate to the employment of this fuel for various purposes, either alone, or mix-

ed with bituminous coal. It is to be regretted, that hitherto, so few experiments have been instituted to test its applicability to various purposes in the arts; the difficulties which were encountered in employing it in domestic economy, were, but seven years ago, by many persons deemed insurmountable; yet it is now managed not only with facility, but with much less trouble than our ordinary wood fires; and but few persons who use it, would be willing to substitute for it, bituminous coal. In England the want of a sufficient quantity of wood to convert into charcoal, was once thought to be an insurmountable obstacle to the extension of the manufacture of iron; and if those who were interested, had rested upon the declaration, that it was impossible to use pit coal for the purpose, what would now have been her resources, her power, or her wealth?

To Joseph Barlow, *of the New Road, in the Parish of St. George, in the East, in the County of Middlesex, Sugar Refiner, for his new invented method or process for bleaching and clarifying, and improving the quality and colour of sugars, known by the name of bastards and piece sugars.*

The sirop extracted from the cane in the West Indies, is boiled to a consistency, which produces that crystallized article called Muscovado sugar, (the superior quality of moist sugar,) the runnings from which, is the West Indian molasses sent to Europe in puncheons. This molasses, when boiled here, produces the brown sugar, called in the trade, bastards.

The ordinary mode of making bastard sugar from the West Indian molasses, is by boiling the molasses in pans or coppers, until the aqueous parts are in a great measure evaporated; then removing the liquor from the pan by means of ladles, and pouring it into earthen moulds of a conical figure, where the remaining molasses descends to the bottom of the vessel, and leaves the sugar above in a crystallized state. After a day or two, the lower end or apex of each conical mould is opened, and the molasses allowed to run out into a pot, leaving only the crystals of sugar in the mould, which in that state is called bastard sugar.

In order to clarify and bleach this sugar, the tops of the moulds are coated, a few inches thick, with a solution of clay in water, stirred up to a stiff consistency; and as the water descends from the clay through the sugar, (which usually takes about a week,) the colouring matter is absorbed by it, and passes off in the state of a thick brown sirop, or molasses, at bottom; leaving the sugar above, considerably whitened; but in this process, a portion of the sugar itself is dissolved and taken up by the water, and consequently the quantity remaining in the mould becomes reduced; and the sirop or molasses, which thus runs from the moulds, being sold at a small price, causes a very considerable loss to the maker.

To obviate this objection to the ordinary process, and save that portion of sugar which usually descends into the molasses, or sirop,

the present invention is proposed; which consists in employing a quantity of molasses in the state in which that article is received from the West Indies, as a bleaching material, instead of the clay and water.

The bastard sugar being in a crystallized state in the mould, as above described, with the colouring matter in it, it is proposed to pour upon the top of the sugar in the mould, a quantity of the West Indian molasses; which, after a few hours, will have passed through the mass, and have carried the colouring matter with it, without reducing the quantity of sugar that had been previously crystallized in the mould. If the molasses should happen to be too thick for the purpose, it may be reduced by the addition of a quantity of water; experience alone, can determine the suitable thickness.

There are three modes of producing bastard sugar; (viz.) boiling the West Indian molasses by itself, boiling the sirop which runs from the process of refining or making lump sugar, and boiling the said sirop and West Indian molasses together. It sometimes happens that broken lumps, which is called piece sugar, is mixed with the molasses to assist the crystallization; whatever, therefore, be the mode by which the sugar is produced, the improved mode of clarifying and bleaching appears; the claim of the patentee being the employment of molasses for extracting the colouring matter from sugars, in the manner above described.

To Francis Henry William Needham, *of Davis Street, Fitzroy Square, in the County of Middlesex, Esq. for his Invention of an improved method of casting steel.*

These improvements in casting steel, consist in melting the steel in large quantities in capacious pots, crucibles, or other suitable vessels, which are to be fixed in furnaces; and when so melted, the steel is to be run from the fixed crucibles, through lateral tubes to the mould, instead of withdrawing the melting pot from the furnace and pouring off the metal, as in the ordinary mode of casting.

In the furnace (which may be constructed according to any of the usual plans) it is proposed to fix the crucibles or melting pots upon fire-brick or stone bearers, so as to allow the fire to envelop them in a similar way to the retorts for generating gas. The crucibles or melting pots are to be made of fire-stone, Stourbridge clay, or any other material that will sustain the action of the fire; they are formed something in the shape of troughs or deep dishes with moveable covers, and are placed upon the bearers, inclining a little from the horizontal. At the lower part of the crucible, an aperture is made, from which a tube extends to the outside of the furnace; and when the steel is perfectly fused, a plug or stopper is to be withdrawn from the outer extremity of the tube, and the fluid metal allowed to run off, which the inclined position of the crucible will facilitate.

In this way, a single crucible or melting trough, or two or more crucibles or melting troughs, may be fixed in one furnace, the fire being made to act upon them all at the same time; by which means a larger quantity of steel may be fused for casting, than in the moveable crucibles, and consequently articles of greater magnitude and substance may be cast in steel by these means, than by the modes heretofore adopted.

As steel of different qualities, requires different degrees of heat to bring it into fusion, it will be necessary to place that steel which is least fusible, in the crucible most powerfully acted upon by the fire; and the more easily fusible, in the upper crucibles; by which means the patentee considers that he shall be enabled, in casting large and heavy articles, such as shafts or cylinders, to employ steel of the best quality, in casting such parts of the article as require it, and an inferior kind of steel, in the other parts; consequently, he expects to produce such articles at a less expense. For instance, in casting a large cylindrical roller of steel, the interior of which might be of an inferior quality of steel, he places a cylinder of wrought iron within the mould as a partition, and causes jets of fluid steel of dissimilar qualities, to flow at the same time from two of the crucibles, into the mould; by which means the fluid steel would adhere to the wrought iron cylinder, and thereby form a solid roller. In casting articles of smaller dimensions in steel, such as horse shoes, hammers, axletrees, and other things which have usually been forged, it is proposed to employ portable iron moulds, which when properly braced together, are to be brought under the jet of fluid steal, and held in such positions that the metal may flow into the bottom of the mould, and thereby drive the air upwards, which must be allowed to escape through small apertures.

The specification concludes by saying, the claim of invention consists in "employing fixed crucibles or melting pots for the fusion of steel, which are to be seated in a furnace, and in causing the fluid steel to flow through pipes or tubes, from the crucible to the moulds. In adapting this invention, I do not mean to confine myself to the form or dimensions of the melting pots, but to employ such forms and dimensions as circumstances may render eligible; neither do I confine my invention to any particular form or construction of furnace, but mean to employ such furnaces as may be found best suited to the adaptation of my invention."

To Louis Lambert, *of Rue de la Gout, in the City of Paris, in the Kingdom of France, but now residing in Cannon-street, in the City of London, Gentleman, for his Invention of certain Improvements in the Materials and Manufacture of Paper.*

These improvements consist in reducing straw into pulp suitable for making paper, and in extracting the colouring or other matter therefrom. The method is this; first, to procure a quantity of straw and cut away all the knots, (any particular kind of straw is not

mentioned,) the straw is then boiled with quick lime in water, for the purpose of extracting the colouring matter, and separating its fibres. Caustic potash, soda, or ammonia may be employed for this purpose, instead of lime. When this is done, it is to be washed in clean water, in order to remove the colour that has been extracted, and also the slaked lime. The fibrous substance is then submitted to the action of a hydro-sulphuret, composed of quick lime and sulphur in solution, in the proportion of four ounces of quick lime to one of sulphur, with one quart of water, in order to get rid of the mucilaginous and silicious matters. After this the fibrous material must be thoroughly washed in successive waters, until all the alkaline matters are removed, and there is no smell of the sulphur left; this may be done by beating in a paper mill, or by any other economical means: it is then pressed to extract the water from the fibres, and bleached in the ordinary way, either with chlorine, or with lime, or by exposure to the light and air, upon a grass plat.

The bleaching process having been completed, the material is again washed until all chymical matters are entirely removed from it, when it is considered fit to be introduced to the ordinary rag engine, employed in making paper, for the purpose of reducing it to pulp, previously to moulding it into sheets.

Dressing Hats by Machinery.

A Patent has been granted to Edward Ollerenshaw, of Manchester, Hat Manufacturer, for a method of dressing and finishing hats, by means of machinery. To effect this, the hat is fixed upon a block in the usual manner; the centre piece of the block is furnished with a screw, by which it may be attached to a lathe, it is then made to revolve with a slow continuous motion, making about twenty turns in a minute; the workman holds in his left hand, a small cushion covered with plush, which he applies to the hat on the far side, whilst the hot iron is passed in succession over every part of the crown. When this is finished the hat is fixed upon a horizontal lathe, where the tip or flat top of the hat is dressed in the way before described; it is then removed to a third spindle, running horizontally, and furnished with a suitable support for the brim, the top surface of which is then finished. To complete the operation, the hat is removed to another horizontal lathe, prepared to receive the crown, so that the lower part of the brim may be turned upwards, it being at the same time properly supported by a rim of wood in a suitable shape. It is now made to revolve with about half the former velocity; which, whilst it presents every part in succession to the workman, admits of his drawing the heated iron, from the inner, towards the outer edge of the brim. Each of these operations is repeated a second time, when the dressing is completed.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. II.

On Mechanics' Liens.

The Legislature of Pennsylvania have passed several acts, with the declared intention of securing to Mechanics, and others, payment for their labour and materials in erecting any building.

The first of these laws is dated April 1, 1803. It was probably meant as an *experiment*, for it was limited to three years; and being, in some respects, defective, was repealed in 1806, shortly before the time that it would have expired by its own limitation.

The second and principal law now in force, was passed on the 17th of March, 1806, and is without limitation.

To this Act a Supplement was made on the 28th day of March, 1808.

The two first of these laws were originally confined to a very narrow district, but by the third and various other statutory provisions, their benefits have been extended to many other parts of the state. Upon these laws, various decisions of our courts have taken place, which will be noticed in their order. There is scarcely a reader of this Journal, to whom a general knowledge of the law of liens is entirely unimportant. To all the various mechanics and material men, who are concerned in the erection of a building, the proper understanding of laws designed for their peculiar benefit, is an advantage so obvious, that it need not be insisted upon; and a few moments reflection will convince us that many others have an interest in this subject. The mechanics' lien, if effectual, operates not only on the *house*, but upon the *ground*, whereon it is erected; and hence it is that its provisions are important to all who are landholders. When properly attached, it is preferred before all *other liens*, which originate subsequently to the commencement of the building; every person, therefore, who takes the common securities of a mortgage, or judgment bond, or who recovers a judgment in one of our courts, will be unable to understand the extent of his security, if he is entirely ignorant of this system. I therefore, was not at all surprised at the desire which was expressed by a number of the members of the Institute, to publish these essays. If I shall be able to comply with the request to the satisfaction of my readers, I shall be much gratified.

A proper consideration of these Laws will involve the following questions.

1. What is necessary to a create a lien.
2. Upon what the lien shall attach.
3. The nature of the preference given.
4. The time the lien may exist.
5. The manner of entering a lien, or instituting a suit.
6. The proceedings to recover the amount of a lien.
7. The consequence of a deficiency of assets to pay all the lien creditors.

8. The duty of the lien creditor upon the receipt of his debt; and the consequence of not performing it.

1. What is necessary to create a lien.

There must be a contract. This will lead me to enquire,

As to the *parties* to the contract.

The *subject matter* of the contract.

The *time* within which the contract is executed.

The *place* over which the contract operates.

That there must be a contract, appears to be clear from the wording of the law of 1803 and 1806; and the lien must arise out of such *contract*, express or implied. The words are "all and every dwelling house and other building, &c. shall be subject to the payment of the *debts contracted* for, or by reason of any work done or materials found," &c.

If, therefore, we could suppose any one to be so foolish as to labour or furnish materials in erecting a building without *any contract whatever*, such a man, I apprehend, would have no lien. I wish, however, to be understood to speak of a case of *no contract whatsoever, express*, or *implied*. We must distinguish between *the contract*, and *the evidence* of the contract. This contract like all others, may be established by *positive* or *presumptive testimony*.

Parties to the Contract.

The Mechanics or Material Men.—The act of 1806, like the previous one of 1803, enumerates eleven descriptions of persons, as lien creditors, viz:—the brick-maker, brick-layer, stone-cutter, mason, lime-merchant, carpenter, painter and glazier, ironmonger, blacksmith, plaisterer, and lumber merchant.

There are, however, it is well known, many other persons, who contribute their labour or materials, in the erection and construction of a building; as for instance, the cellar, foundation, and well digger, the curb-stone merchant, the paver, the tile-merchant, the slate merchant, the tiler, the slater, the plumber, the copper-smith, the tin-plate worker, the turner, the paper stainer, the paper-hanger, the bell-hanger, the wall-stainer, and perhaps others. It becomes an important question, therefore, whether these, or any of them are included in the statutes.

What was the intention of the legislature? for that ought to be the *polar star*, to guide us in the construction of statutes. Did they mean, by enumerating the eleven persons above named, to exclude *all* others, according to the maxim "*expressio unius est exclusio alterius?* or were *they* put merely by way of *example?* If we were to weigh the mere *probabilities* of the case, the argument would, it appears to me, preponderate in favour of some of the persons not enumerated. If they contribute their labour, or their materials, they are equally meritorious with those specified; and it is alike inconsistent with the principles of equity, and the equality of rights, which are the basis of our government, to grant greater securities to one class of citizens, than to another. But we are not

obliged to resort to *probabilities*, for we have the express declaration of the legislature, that the preference shall be given, not only to the mechanics and material men enumerated, but "to any other person or persons employed in furnishing materials for, or in the erecting and constructing such house or other building."

These expressions plainly bespeak the opinion of the legislature, that *all* the persons who were to be aided by the act, were *not specially* mentioned; but that others were meant to be included in this general clause; and our courts confirmed this construction of the act, the moment they admitted *any one person* to participate, who was not among those enumerated.

It remains then to enquire into the extent and limit of this admission. The word "*other*," has, in statutes, as in common parlance, an extensive signification. The st. 13 Eliz. c. 5. enacts that all feoffments, gifts, grants, &c. to delay, hinder, or defraud creditors and *others* of their just and lawful actions, &c. shall be void. And it has been decided, that this statute doth extend not only to creditors, but to *all others*, who had cause of action or suit, or any penalty, or forfeiture, &c. 3 *Co.* 82. But the clause in the act of 1806, not only speaks of "*another*," but "*any other*," thereby giving the greatest possible latitude of admission. Justice and reason seem therefore to coincide in favour of admitting *any person* employed, as the act describes, in furnishing materials for, or in the erecting or constructing of a building.

I have been informed that very soon after this act was passed, it was decided that the person employed to dig the cellar of a house, was adjudged to have a lien. I will not vouch for the accuracy of the information, but this I am enabled to say, that the general understanding at the bar, as far as I have been able to collect it, is, that the persons who dig cellars, are entitled to a lien, and the uniform practice has been to admit them, without opposition; which furnishes strong evidence that such has been the decision.

The act creates a lien in favour of those who furnish materials or perform labour in paving with stone between the foot pavements of a court, laid out for the convenience of buildings erected fronting on the same.

This point came before the district court for the city and county of Philadelphia, in January, 1815, in the case of M'Ilhenny and others, *vs.* Pratt and others.

In the case of Leiper, *vs.* Smith, the judges, (M'Kean and Barnes) decided that there was no lien for curb-stone.

By the second section of the act of the 24th of March, 1819, it was enacted "that the act of 1806 should be extended to any person or persons furnishing curb-stone for the pavement of any house or building, erected within the meaning of the act, and that the person so furnishing curb-stone, as aforesaid, should enjoy all the benefits and advantages of the said act and the supplement thereto, as fully and effectually as if they had been therein particularly mentioned."

This legislative provision in favour of persons furnishing curb-stones, is not *conclusive* evidence that they were not concluded in the former act. A great luminary of the law informs us, that one function of the legislative branch of the government is, *to correct the mistakes and unadvised determinations of unlearned* (or even learned) *Judges*.—1. Black. Com. 86.

Justice to the bench requires that we should likewise say, that it furnishes no conclusive evidence that the court were wrong; for the omission *may* have been in the law of 1806. The question is open.

The paper-stainer and paper-hanger have no lien on the building.

This was decided in the district court for the city and county of Philadelphia, judges Ingersoll, M'Kean and Morgan, in the case of Hurley, *vs.* Lybrand, after argument by Mr. Kittera for Hurley, and Mr. H. Hopkins for Lybrand.

The plumber has no lien on the building.

This was decided by the district court for the city and county of Philadelphia, judges Ingersoll, M'Kean and Morgan, in the case of Rowley & Alberger, *vs.* Lybrand, after argument by Mr. Potts for Rowley & Alberger, and Mr. H. Hopkins for Lybrand.

And although *journeymen* would be included within the *literal* meaning of the terms "any other person or persons employed in furnishing materials for, or in erecting and constructing such house or other building," yet they have no lien.

This point, concerning the journeymen, was decided in Cobb, *vs.* Traquair. The suit was brought in the district court for the city and county of Philadelphia, in December term, 1819. No. 859. It was tried on the 27th of March, 1820, Mr. Kittera for the plaintiff, and Mr. Swift for the defendant, and a verdict was given for the defendant. On the 30th of March, 1820, Mr. Kittera moved for a new trial, and filed the following reason.

"The court erred in charging the jury that the plaintiff had no claim for work done to the defendant's building, because he was not the original contractor, but worked under Richard Ware, who made the contract with the defendant." The rule was granted on the 29th of April, and on the first day of May, after argument before judges M'Kean and Barnes, the rule was discharged.

FOR THE FRANKLIN JOURNAL.

ON HARDENING STEEL DIES.

Mr. Editor,—I avail myself of the opportunity you offer, to record in your useful repository, the observations made by ingenious practical mechanics, in the prosecution of their respective arts. It will no doubt comport with your views, to give to merit its just due, by stating the origin of processes already known, as well as to make the knowledge of them, more extensive.

The management of steel for nice purposes in the arts, is of vast importance, and requires considerable practical skill; it has consequently been made the subject of numerous experiments, which within the course of a few years have resulted in the discovery of many improvements. The general method of hardening this metal, is to heat it red hot, and then to plunge it into cold water, and sometimes into mercury, in order to reduce its temperature as quickly as possible; to effect this cooling with the requisite rapidity, the article when plunged, is moved about, in order to expose it to new surfaces of the cold fluid. This method answers in general, with small or thin pieces of steel, but not when the mass is considerable; in this case, the article frequently breaks in the operation, or is hardened at the edges only; from this cause much inconvenience, and great loss, have frequently resulted to those interested in the hardening of steel dies, for striking medals, coins, &c. This has been frequently experienced in the mint of the United States; the dies after being completely finished, excepting the process of hardening, were very often destroyed in this attempt; or if they passed safely through this ordeal, were found to be incapable of sustaining the severe and repeated blows to which they, in their use, were subjected. An intimate friend of the writer, it is believed, was the first person who succeeded in obviating these difficulties so completely, that not the slightest danger is now apprehended from the process.

Mr. Adam Eckfeldt, the present chief coiner in the mint, a very ingenious practical mechanic, whose original profession was that of a smith, was employed in the infant state of the establishment, to manage this department. Aware that the cause of the frequent failures in the process alluded to, was the sudden contraction of the steel on the outside, whilst the inside was in a heated and expanded state, causing the outer hardened and brittle coat of steel to crack or burst, he adopted the following expedient. He caused a vessel holding 200 gallons of water, to be placed in the upper part of the building, at the height of 40 feet above the room in which the dies were hardened; from this vessel, the water was conducted down through a pipe of one inch and a quarter in diameter, with a cock at the bottom, and nozzles of different sizes, to regulate the diameter of the jet of water. Under one of these was placed the heated die, the water being directed on the centre of the upper surface. The first experiment was tried in the year 1795, and the same mode has been ever since pursued, without a single instance of failure.

By this process the die is hardened in such a way, as best to sustain the pressure to which it is to be subjected, and the middle of the face, which by the former process was apt to remain soft, now becomes the hardest part. The hardened part of the die so managed, were it to be separated, would be found to be in the form of a segment of a sphere, resting in the lower soft part, as in a dish; the hardness of course gradually decreasing as you descend to-

wards the foot. Dies thus hardened, preserve their forms until they are fairly worn out.

I am aware that the above mode is now in frequent use, as Mr. Eckfeldt never wished to keep it secret; a gentleman of the mint, communicated the process to a friend in Birmingham, England, where, it is believed, it was not previously known.

Should you think the above information worth publishing, you will probably receive some other communications, containing improvements effected by the same gentleman.

Yours very respectfully,

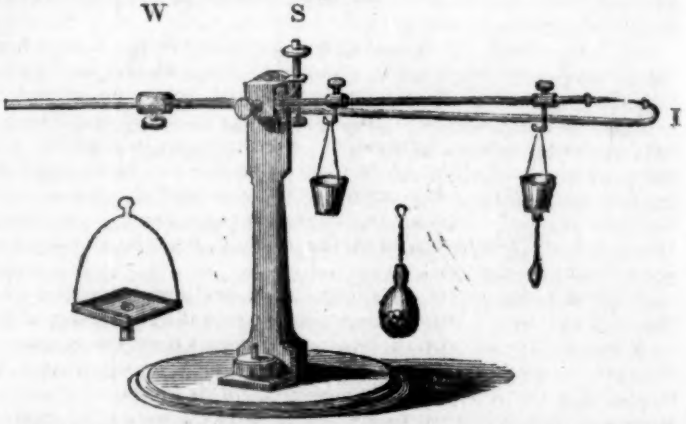
K.

ON SPECIFIC GRAVITY.—No. II.

By Robert Hare, M. D. *Professor of Chymistry in the University of Pennsylvania.*

To find the specific gravity of a Mineral, without calculation, and without degrees.

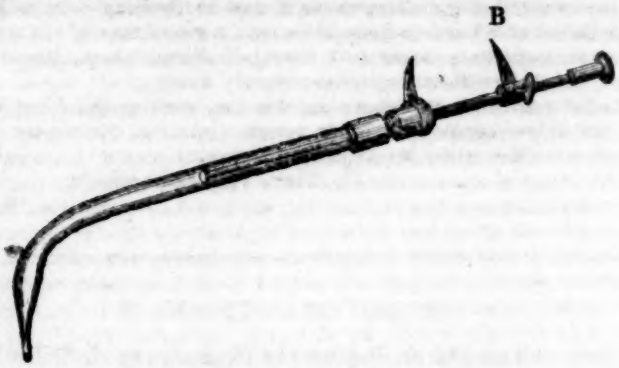
Fig. 5.



The preceding figure represents a balance employed in this process. It is, in two respects, more convenient than a common balance. The moveable weight on one of the arms, renders it easier to counterpoise bodies of various weights; and, the adjustment of the index (I) by the screw (S) to the beam, saves the necessity of adjusting the beam to the index; the accurate accomplishment of which, by varying the weights, is usually a chief part of the trouble of weighing.

One of the buckets, suspended from the beam, is five times as far from the fulcrum as the other.

A chyometer is employed in this process, of which the following figure will convey a correct idea.



The rod of this instrument is not graduated, but is provided with a band, (B) which can be slipped along the rod, and fastened at any part of it by means of a screw.

Let a mineral be suspended from the outer bucket, and rendered equiponderant with the counter-weight, (W) by moving this further from, or nearer to the fulcrum, so that the index point (I) may be exactly opposite the point of the beam. Place under the mineral a vessel of water, and add as much of this fluid to the bucket, by means of the chyometer, as will cause the immersion of the mineral. The band (B) which is made to slip upon the rod, should be so fastened, by means of the screw, as to mark the distance which the rod has entered, in expelling the water, requisite to sink the mineral. Having removed the vessel of water, and the mineral, ascertain how many times the same quantity of water, which caused the immersion of the mineral, must be employed to compensate its removal.

Adding to the number, thus found, one, for the water, (previously introduced into the bucket, in order to cause the immersion of the mineral) we have its specific gravity; so far as it may be expressed without fractions. When requisite, these may be discovered by means of the second bucket, which gives fifths for each measure of water; which, if added to the outer bucket, would be equivalent to a whole number. By the eye, the distance is easily so divided, as to give half fifths, or tenths. Or, the nearest bucket, being hung one half nearer the fulcrum, the same measures will become tenths in the latter, which would be units, if added to the outer bucket.

Rationale.

The portion of the rod, marked off by the band, was evidently found competent, by its introduction into the tube of the chyometer, to exclude from the orifice a weight of water, adequate to counteract the resistance encountered by the mineral in sinking in wa-

ter: consequently, agreeably to the general rule,* to find the specific gravity of the mineral, we have only to find how often this weight (of water) will go into the weight of the mineral—or, what is the same in effect, how often the former must be taken, in order to balance the latter. Indeed it must, otherwise, be sufficiently evident, that the mineral and the water being made equal in weight, their specific gravities must be inversely as their bulks, which are known by the premises.

The inner bucket may be dispensed with, and greater fractional accuracy attained, by means of a sector, graduated into 100 parts. It is for this purpose that the sliding band, and the ferrule at the but-end of the tube, are severally furnished with the points. The assistance of a sector is especially applicable, where fluids are in question, since it is necessary to find their differences in thousandth parts.

To find the specific gravity of a liquid, by the Sectoral Chyometer.

Let a glass bulb, (represented in figure 5, under the buckets,) be suspended from the outer bucket, and counterpoised. Let the situation of the beam be marked, by bringing the point of the index opposite to it. Let the tube of the chyometer be full of water, and the rod retracted, until stopped by an enlargement purposely made at its inner termination. Next return it into the tube, until as much water is projected into the bucket, as is just adequate to cause the immersion of the bulb. Let the band be fastened upon the rod, close to where it enters the tube, so as to mark the extent to which it may have entered. The rod must in the next place, be drawn out from its tube, to its first position; and the sector so opened, as that the points may extend from 100 degrees on one leg to 100 upon the other. Leaving the sector thus prepared, place under the suspended ball, a vessel containing an adequate quantity of the fluid, whose gravity is required. If the fluid be lighter than water, in order to cause the immersion of the bulb in it, the rod will not have to enter so far, as at first. This distance being marked, by fixing the sliding cylinder, and the rod withdrawn from the tube as far as allowed by the stop, the number on each leg of the sector, with which the points will coincide, gives the gravity of the fluid. Forcing as much water into the bucket as had been sufficient to sink the bulb in water, will not sink it in a heavier liquid; consequently, in the case of such liquids, it will be necessary to fill the chyometer a second time, and force as much more water from it, as may be sufficient to cause the immersion of the bulb. The sliding band being then fixed, and the points separated and applied to the sector, as before, the number to which they extend must be added to the weight of water = 100, for the specific gravity of the fluid in question.

Small differences are better found by subtraction; as, for instance, suppose the specific gravity of the fluid were 101; after the small

* See No. 1, page 44.

addition of water made to the bucket, beyond the 100 parts required for the immersion of the bulb *in water*, (the band being unmoved), the points would extend from 99 on one leg, to 99 on the other. The difference between this number, and 100, is then to be added to the weight of water; so that the specific gravity is found to be 101.

The angle made by the sectoral lines in using the same bulb, and the same rod, will always be the same. Hence, a stay may be employed to give the sector the requisite opening.

Indeed, were liquids alone in question, an immoveable sectoral scale would answer. Thus prepared, it were unnecessary to have recourse to water, excepting in the first adjustment of the scale. The number of parts required to merge the bulb in any fluid, will reach (at once or twice) the number, or numbers, on the sector, which give the required gravity.

In this process, if greater accuracy be desirable, it is only necessary to employ a smaller rod or a larger bulb. Instead of effecting an immersion by one stroke of the rod, it may be done by ten strokes, which will make each division of the sector indicate a thousandth of the bulk of the bulb.

The following process is, however, preferable, as the sector is made to give the answer in thousandths, without the delay of filling and emptying the chyometer more than once.

Let the distance on the rod of the chyometer be ascertained; which, when introduced five times successively, will exclude just water enough to overcome the resistance encountered by a globe, in sinking in that fluid. Let the sector be opened, to the distance so designated: let the globe be partially counterpoised, so as to float in any liquid heavier than 800. The apparatus being thus prepared, if the globe be placed in a liquid, in which it floats, add as much water, from the chyometer, to the scale, from which it hangs, as will sink it—and, by means of the points and the sector, ascertain the value of the distance to which the rod has been introduced. Adding the numbers, thus found, to 800, the sum will be the specific gravity of the liquid.

For this process, the sector should be divided into 200 parts, and, the proper opening being once duly ascertained, should be preserved by means of an arc, like that attached to common beam compasses.

Instead of a globe, a hydrometer, surmounted with a cup, may be employed, either with a graduated, or a sectoral, chyometer.

Before taking leave of the reader, it may be proper to explain the use of the square dish, which may be seen to the left, under the beam, (figure 5.) The arc of wire is for the purpose of suspending the dish to the hook, in place of the outer bucket. When so suspended, filled with water, and duly balanced, it will be found soon to become sensibly lighter, in consequence of the evaporation of the water. By means of the chyometer, it is easy to ascertain the different quantities evaporated, in similar times, at different periods, and in different places; so that, guarding against the effect

of aërial currents, hydrometrical observations may be made with great accuracy.

In lieu of having points attached to the chyometer, as represented in the figure, it may be as convenient to have two small holes, for the insertion of the points of a pair of compasses, either of the common kind, of the construction used by clock makers, or that which is known under the name of beam compasses.

The compasses may be used to regulate the opening of the sector, or to ascertain, by the aid of that instrument, the comparative value of the distances which the rod of the chyometer has to be introduced into its tube.

In order to convey an idea of the nature of the sector to any reader who may be unacquainted with it, I trust it will be sufficient to point out, that its construction is similar to that of the foot-rule used by carpenters. We have only to suppose such a rule, covered with brass, and each leg graduated into 200 equal parts, in order to have an adequate conception of the instrument employed by me.

A more particular explanation of the principle of the sector, may be found in any Encyclopedia, or Dictionary of Mathematics.

WATER WHEELS.

On the construction of water wheels and the method of applying the water for propelling them so as to produce the greatest effect.

To the Committee of the Franklin Institute in Philadelphia.

In constructing water-wheels, especially those of great power, the introduction of iron is a most essential improvement, and if this metal, and artisans skilled in the working it, could be obtained at reasonable rates, water wheels might be made wholly of it, and prove ultimately the cheapest, as if managed with due care, and worked with pure (not salt) water, they would last for centuries; but as the first cost would be an objection, I would recommend in all very large wheels that the axis be made of cast iron, and in order to obtain the greatest strength with the least weight, the axis or shaft ought to be cast hollow, and in the hexagon or octagon form, with a strong iron flange to fix each set of arms and the cog wheel upon; these flanges to be firmly fixed in their places with steel keys.

On the adaptation of water wheels to the different heights of the water falls by which they are to be worked, I remark that falls of 2 to 9 feet are most advantageously worked with the undershot wheel; falls of 10 feet and upwards by the bucket or breast wheel, which up to 20 or 25 feet ought to be made about one-sixth higher than the fall of water by which it has to be worked; and in wheels of both descriptions, the water ought to flow on the wheel from the

surface of the dam. I am aware that this principle is at direct variance with the established practice, and perhaps there are few wheels in these states that can be worked as they are now fixed, by thus applying the water; the reasons will be apparent from what follows.

In adjusting the proportions of the internal wheels by which machinery is propelled, it is necessary, in order to obtain the greatest power, to limit the speed of the skirt of the water wheel, so that it shall not be more than from 4 to 5 feet per second; it having been ascertained by accurate experiments, that the greatest force of water obtainable, is within these limits. As a falling body, water descends at the speed of nearly 16 feet in the first second, and it will appear evident that, if a water wheel is required to be so driven, that the water with which it is loaded has to descend 10, 11, or 12 feet per second, at which rates wheels are generally constructed to work, that a very large proportion of the power is lost, or rather, is spent, in destroying, by unnecessary friction, the wheel it is flowing upon.

In the common way of constructing mill work and of applying water to wheels, it has been found indispensably necessary to have a head of from 2 to 4 feet above the aperture through which the water flows into the buckets, or against the floats of a water wheel, in order to be able to load the wheel instantaneously, and without which precaution it could not be driven at the required speed; from this circumstance it has been erroneously inferred that the impulse or shock which a water wheel so filled receives, is greater than the power to be derived from the actual gravity of the water alone. This theory I have heard maintained among practical men, but it is, in fact, only resorting to one error to rectify another. Overshot wheels have been adopted in numerous cases merely for the purpose of getting the water more readily into the buckets—but confine the wheel to the proper working speed, and that difficulty does not exist.

In consequence of the excessive speed at which water wheels are generally driven, a small accumulation of backwater either suspends or materially retards their operations, but by properly confining their speed, the resistance from back water is considerably diminished, and only amounts to about the same thing as working from a dam as many inches lower as the wheel is immersed; and in undershot wheels worked from a low head, or situated in the tide-way, the resistance from back water may be farther obviated by placing the floats not exactly in a line from the centre of the wheel, but deviating 6 or 8 inches from it, so as to favour the water leaving the float ascending.

In constructing water wheels to be driven at the speed of 4 to 5 feet per second, it will be requisite to make them broader to work the same quantity of water which is required to drive a quick speeded wheel. Thus if a person intending to erect a mill, has a stream sufficient to work a wheel 5 feet broad, the skirt to move 10 feet per second, it is evident that if he wishes to work all the

water which such wheel takes, he must have his wheel 10 or 12 feet broad, instead of 5, otherwise the water must run to waste, as there would not be room in a slow moving wheel of 5 feet broad to receive more than half of it. The principal advantages resulting from the proposed method of adapting wheels to the falls by which they are to be worked, and the method of applying water, are:

1. The lessening of friction upon the main gudgeons, (and first pair of cog wheels,) by which, with a little care, they may be kept regularly cool, and the shaft or axis be preserved much longer in use than when the gudgeons cannot be kept cool.

2. By working water upon the principle of its actual gravity alone, and applying it always at the height of the surface of the dam, its power is double what is obtained by the common method of applying it.

3. The expensive penstock required to convey the water to the wheels, generally used, will not be needed, as one much shallower, and consequently less expensive, will be sufficient.

4. The resistance of back water is reduced as far as possible.

5. The risk of fire is less, as the friction is reduced.

I shall close this paper with remarks upon those establishments I have inspected in the course of the present year.

Mr. Smith's newly erected corn mill on the Rariton, at New-Brunswick, N. J., has water wheels 16 feet high and 14 feet broad, which are worked by a head of four feet. The water wheels make 12 revolutions per minute, equal to 10 feet per second, when the stones (five feet diameter) make 100 revolutions.

The water wheels at the flour mills at Brandywine, near Wilmington, are worked at the speed of 10 to 15 revolutions per minute, the wheels generally 16 feet high, and the fall 20 feet.

In all these establishments, there is not obtained 50 per cent. of the power of the water used.

The water wheels at Fair Mount, used for supplying Philadelphia with water, are 16 feet high and 14 feet wide, worked by a head of 5 feet; they are driven at the rate of 13 revolutions per minute, which is equivalent to 11 feet per second for the motion of the skirt of the wheel.

The machinery used here, is highly creditable to the workmen who put it up; but if the principle of applying water, which I have endeavoured to establish, be correct, it will be readily perceived, that a very considerable loss of power is sustained by its mode of application.

If these water wheels, as situated at present, were confined to make no more than 5 revolutions per minute, and the pumps to make the same number of strokes that they now do, that is 13 double strokes, the water flowing against the wheel at the surface of the dam; each wheel would work two of the pumps, with the water that is now taken to work one. But if the wheels were placed 18 inches lower in the tide-way, two-thirds of the water required to work one pump, would work two at equal speed, while the wheel continued free, and it would require no more than is now used to

work one pump, to work two with the wheel immersed 18 inches in the tide. This will, I trust, be sufficiently clear, when it is considered, that by the reduced speed, an addition of 150 per cent. in the quantity of water is thrown into the wheel and kept there, together with the advantage gained between the water descending four and one-eighth instead of 11 feet per second.

September 24, 1825. W. PARKIN, Engineer.

STEAM ENGINES.

The subjoined account of the steam engines in use in Glasgow and its vicinity, at the beginning of the year 1825, exhibits a creation of physical force, applied to the purposes of manufacturing, within the short space of thirty-three years, which is well worthy the notice of the city of Philadelphia. The population of the two cities is nearly equal, and the conviction is general, that *we* are well situated for the business of manufacturing, and that our prosperity is intimately connected with its establishment. Besides those manufactures extensively carried on in Glasgow, there is one of vast importance, and which it is in our power extensively to prosecute; the manufacture of broad-cloth and other fabrics of wool, either alone or in mixture. Enough has been done in the United States, to prove that in nearly every department of that business, labour-saving machinery may be employed, with advantages equal to those exhibited in the manufacture of cotton. It is the determination of the Editor to present this subject more fully, in an early number of this journal, as the views which it opens are too numerous and too important, to be dismissed in the compass of a few lines.

The corporation of the city would, it is believed, pursue a policy as wise as it would be liberal, were they for a limited time, to allow the free use of the Schuylkill water, for the supply of all the steam engines, which should be built, and applied to manufacturing purposes, within a certain period. This might be done without any present loss; whilst it would tend to give that activity to industry, value to property, and employment to capital, which would immediately, although indirectly, more than pay the tax; whilst, eventually, a new source of revenue would be opened.

We are wisely lavish in the use of water, in order to preserve the property of our citizens in case of fire. Would not the wisdom be equal, which should freely apply a portion of it to promote the creation of property, which otherwise may never come into existence?

An account of the Steam Engines now employed at Glasgow, and in its neighbourhood. Extracted from "An Historical account of the Steam Engine, and its application in propelling vessels. By Mr. JAMES CLELAND, *superintendant of public works for that city, member of its Chamber of Commerce, &c. &c."*—Glasgow, 1825.

"The first Steam Engine erected in Glasgow, for spinning cotton, was put up in January, 1792, in Messrs. William Scott & Co.'s

(afterwards Tod & Stevenson's) Cotton Mill, near Springfield, nearly opposite what is now the Steam Boat Quay. This was seven years after Messrs. Boulton & Watt put up their first Steam Engine for spinning cotton, in Messrs. Robinson's mill, at Papplewick.

Number of Steam Engines in the city of Glasgow and its suburbs, in April, 1825.

Mannfacturers' Names.	Horse Power of Engine.	How employed.
Glasgow Water Works, 5 engines, 1 of 70, 2 of 30, 1 of 20, and 1 of 10 horse power,	160	Raising Water.
Robert Thomson & Son, 3 engines, 1 of 48, 1 of 25, and 1 of 20.	93	Spinning Cotton.
Cranstonhill Water Works, 3 engines of 30 each,	90	Raising Water.
Corporation of Bakers, 2 engines, 1 of 42, and 1 of 32,	74	Grinding Flour.
J. Bartholomew & Co. 2 engines, 1 of 60, and 1 of 12,	72	Spinning and Weaving.
John Monteith, 3 engines, 1 of 32, 1 of 25, and 1 of 14,	71	Spinning and Weaving.
Claud Girdwood & Co. 2 engines, 1 of 36, and 1 of 25,	61	Engine and Machine Making, Founding and Weaving.
David Todd, 2 engines, 1 of 35, and 1 of 16,	51	Spinning Cotton.
Macleroy, Hamilton & Co.	50	Spinning and Weaving.
John Miller,	48	Spinning and Weaving.
James Corbet & Co. 2 engines, 1 of 32, and 1 of 14,	46	Spinning and Weaving.
Henry Houldsworth,	45	Spinning Cotton.
Lancefield Spinning Company,	45	Spinning and Weaving.
William Auld, 2 engines, 1 of 24, and 1 of 20,	44	Weaving and Snuff-making.
Henry Monteith & Co. 2 engines, 1 of 32, and 1 of 10,	42	Printing and Discharging.
James Dunlop,	42	Spinning Cotton.
Thomas Hervey,	40	Distilling.
Charles Todd, 2 engines, 1 of 20, and 1 of 18,	38	Weaving.
Muir, Brown & Co. 3 engines, 1 of 20, 1 of 10, and 1 of 8,	38	Bleaching, Dyeing, and Discharging.
Anderson & Co.	36	Lamp Black Making, and Grinding.
Mile-end Spinning Company,	36	Spinning Cotton.
William Hussey,	36	Spinning Cotton.
Thomas Lancaster,	36	Weaving, Printing, and Discharging.
James Crombie, 3 engines, 1 of 14, 1 of 12, and 1 of 10,	36	Spinning Cotton.
John Wilson,	32	Spinning and Weaving.
Finlay, Connal & Co.	32	Spinning Cotton.
Couper, Maitland & Co.	32	Spinning and Weaving.
Bogle & Ferguson,	32	Spinning Cotton.
Colin Gillespie, 2 engines, 16 each,	32	Weaving.
James Oswald & Co.	30	Spinning Cotton.
Charles Tennent & Co.	30	Chymical Operations.
George Buchanan & Sons, 2 engines, 1 of 16, and 1 of 14,	30	Calendering.

William Ewing,	28 - Weaving.
James M'Donald,	25 - Spinning and Weaving.
Dugald M'Phail,	25 - Spinning and Weaving.
James Edington,	25 - Founding and Weaving.
George Forster,	25 - Spinning and Weaving.
William Clark, 2 engines, 12 each,	24 - Weaving.
Reid & Whiteman,	24 - Weaving.
Moses M'Culloch & Co.	24 - Smith Work and Founding.
George Aitken,	20 - Weaving.
John Clark & Co.	20 - Spinning Cotton.
William Perry,	20 - Spinning and Weaving.
Thomas Edington,	20 - Founding and Grain Grinding.
John Glass,	20 - Dyeing and Discharging.
William Sim,	20 - Grain Grinding.
Douglas Wardrop,	20 - Weaving.
M'Lellan & Turner,	20 - Weaving.
John M'Ausland,	20 - Weaving and Cutting Wood.
Angus Shaw,	20 - Spinning Cotton,
Black & Co.	20 - Calendering.
Andrew Smith,	20 - Weaving.
James M. Graham,	20 - Spinning Cotton.
John Black & Co.	20 - Calico Printing.
R. F. & J. Alexander,	18 - Twisting Yarn.
Wardrop & Hervey,	16 - Weaving.
Andrew Campbell,	16 - Weaving.
Daniel M'Phail & Co.	16 - Spinning Cotton.
Patrick Dawson,	16 - Distilling.
John Gourlay & Co.	16 - Distilling.
Brown & M'Nee,	16 - Weaving.
William Kerr & Co.	16 - Calendering.
William Aitken,	16 - Spinning Cotton.
Hector Grant,	14 - Weaving.
Robert Blackburn & Co.	14 - Spinning and Weaving.
Andrew Thomson,	14 - Spinning Cotton.
John Barr & Co.	14 - Spinning Cotton.
Leishman, Dunlop & Co.	14 - Spinning Cotton.
Robert M'Farlane & Co.	14 - Distilling.
John Forsyth,	14 - Pottery and Fire Brick.
J. & A. Monach,	14 - Spinning Cotton.
Rockvilla Mill,	14 - Distilling and Grain Grinding.
Stevenson, M'Lean & Co.	14 - Calendering.
Reid & Jones,	14 - Calendering.
Robert M'Laren,	14 - Spinning Cotton.
John Cairnie & Co.	14 - Distilling.
Glasgow Foundry Company,	14 - Founding.
William Dunn, 2 engines, 1 of 8, and 1 of 6,	14 - Machine making and Spinning Cotton.
James Johnston,	14 - Weaving.
John M'Lean,	14 - Weaving.
Neil Snodgrass,	12 - Spinning Cotton.
Anderston Foundry,	12 - Machine Making & Founding.
David Napier,	12 - Engine Making & Founding.
Francis Marr & Co.	12 - Spinning and Weaving.
John M'Au'ay,	12 - Grain Grinding.
Joseph Scott,	12 - Grain Grinding.
James Taylor,	12 - Calendering.
Malcolm M'Lean & Co.	12 - Calendering.
John Stevenson & Co.	12 - Dyeing and Discharging.
James Cook,	12 - Engine and Machine Making.
H. & R. Baird,	12 - Engine Making & Founding.

Robert Napier,	12 - Engine Making & Founding.
Hamilton Garden,	12 - Raising Water.
Archibald Turner,	10 - Spinning Cotton.
Bowman Fleming,	10 - Bleaching and Dyeing.
Blair & Morrison,	10 - Calendering.
Crawford & Co.	10 - Calendering.
Ure & Bankier,	10 - Calendering.
Murdoch & Cross,	10 - Engine Making & Founding.
Samuel Wilson,	10 - Sugar Refining.
Malcolm Muir & Co.	10 - Veneer Sawing.
Dr. Drew,	10 - Bleaching and Dyeing.
J. & M. Mitchell & Co.	10 - Tambouring.
George M'Intosh & Co. 2 engines, 1 of 6, and 1 of 3,	9 - Chymical and Cudbear Operations.
Anderston Brewery,	8 - Grinding Malt and Pumping Worts.
Donald M'Donald,	8 - Spinning Cotton.
Mrs. M'Kinlay,	8 - Fire Brick Making.
Watt & Archibald,	8 - Turning and Cutting Wood.
Walter M'Queen,	8 - Bleaching and Dyeing.
John M'Kay,	8 - Wool-Carding.
Alexander Herbertson,	8 - Weaving.
James M'Nair,	8 - Sugar Refining.
Robert Struthers,	6 - Grinding Malt and Pumping Worts.
Archibald Liddell,	6 - Grinding Colours.
William M'Andrew,	6 - Engine Making & Founding.
Duncan M'Arthur,	6 - Engine Making.
John Geddes,	6 - Glass Grinding.
Archibald Geddes,	6 - Glass Grinding.
Andrew King,	6 - Weaving.
John Neilson,	6 - Engine Making.
Pollock & Blackie,	6 - Founding.
John Roberton,	6 - Founding.
Charles Gray,	6 - Distilling.
James Fleming,	6 - Bleaching.
James M'Dougal,	6 - Calico Printing.
George M'Leod,	6 - Grinding Drugs.
John M'Intyre,	6 - Smith Work and Founding.
Parlane & Ure,	6 - Calendering.
A. M'Lellan & Son,	6 - Coach Making.
William Bryden & Co.	6 - Coach Making.
Stephen Miller & Co.	6 - Founding.
William Brown & Co.	6 - Grinding Colours.
Samuel Hall & Co.	6 - Singeing Muslins.
William Watson,	6 - Engine and Machine Making.
Thomas Baird & Son,	6 - Dyeing and Printing.
Walter Stewart & Co.	6 - Grinding Malt and Pumping Worts.
Connal & Co.	6 - Distilling.
Port-Dundas Foundry,	4 - Founding.
Archibald Arthur,	4 - Printing and Grinding Indigo.
Gow & Co.	4 - Bleaching and Dyeing.
Gas Work,	4 - Gas.
J. & H. Wardrop,	4 - Coppersmiths.
Apothecary Company,	4 - Grinding Drugs.
Matthew Balmanno,	4 - Grinding Drugs.
John Roxburgh,	4 - Tanning.
John Bell,	4 - Fire Brick Making.
John Fulton,	4 - Founding.

John M'Donald & Sons, - - - 4 - Dyeing and Discharging.
John Spence, - - - - 3 - Smith Work.
Total,—Manufacturers, 149.—Engines, 176.—Horse Power, 2970.

Average power of Engines, $16\frac{875}{1000}$.

Abstract.—*Horse power, how distributed.*

	Horse power.
Spinning Cotton, - - -	893
Weaving, - - - -	665
Raising Water, - - -	262
Bleaching, Dyeing, Printing, and Discharging, - - -	206
Calendering, - - - -	154
Grain Grinding, - - -	153
Founding, - - - -	124
Distilling, - - - -	119
Engine Making, - - -	62
Chymical Operations, - -	39
Machine Making, - - -	37
Snuff Making, - - -	22
Fire Brick Making, - -	19
Sugar Refining, - - -	18
Lamp Black Making, - -	18
Twisting Yarn, - - -	18
Carried forward, -	2809

	Horse power.
Brought forward -	2809
Smith Work, - - - -	18
Grinding Drugs, - - -	14
Coach Making, - - -	12
Glass Grinding, - - -	12
Grinding Malt and Pumping Worts,	20
Grinding Colours, - - -	14
Veneer Sawing, - - -	10
Tambouring, - - -	10
Cutting Wood, - - -	18
Wool Carding, - - -	8
Pottery, - - - - -	7
Singeing Muslin, - - -	6
Gas, - - - - -	4
Coppersmith, - - - -	4
Tanning, - - - -	4
Total, -	2970

The above exhibits the horse power employed in Spinning and Weaving in Glasgow and its Suburbs, extending not more than two miles from the Cross, but gives no idea of the power employed in the Cotton trade at a greater distance, by Glasgow Manufacturers: Messrs. Robert Owen & Co.'s establishment at New Lanark, James Finlay & Co.'s at Deanston, Ballandalloch, and Catrine, and William Dunn's at Duntocher, Paisley, and Milton, alone contain Water Twist and Mule Spindles, equal to 236,000 of the latter description. If the works of Messrs. Henry Monteith & Co. at Blantyre—Wm. Kelly, at Rothsay and Blackburn—and of the other great Manufacturers belonging to Glasgow were taken into account, the extent of business done at these establishments would be shown to be much greater than is generally understood.

Number of Steam Engines employed in Collieries in the neighbourhood of Glasgow.

	Horse power.
Clyde Colliery, 3 pumping engines, 1 of 64, 1 of 54, and 1 of 16; 6 winding engines, 2 of 18 each, and 4 of 11 each. This power includes Hamilton Farm Colliery, - - - - - - - - - -	214
Govan Colliery, 2 pumping engines, 1 of 54, and 1 of 42; 1 pumping and winding, 20; 4 winding, 1 of 18, 2 of 14, and 1 of 9; 1 rotatory engine, 16, - - - - - - - - - - - - -	187
West Muir Colliery, 2 pumping engines, 1 of 78, and 1 of 58; 3 winding engines, 2 of 16 each, and 1 of 10, - - - - - - - -	178
Eastfield Colliery, 2 pumping engines, 1 of 72, and 1 of 54; 2 winding engines, 1 of 23, and 1 of 14, - - - - - - - - -	163
Old Farm Colliery, 1 pumping engine, 72; 2 pumping and winding engines, 19 each; 2 winding engines, 1 of 18 and 1 of 10. This power includes Wellshot Colliery, - - - - - - - - - -	138
Stonelaw Colliery, 2 pumping engines, 1 of 51, and 1 of 35; 3 winding engines, 14 each, - - - - - - - - - - -	126
	1006

	Horse power.
Brought forward, - -	1008
Knightswood Colliery, 1 pumping engine, 56; 3 winding engines, 2 of 10 and 1 of 8, - - - - - - - - - - - -	84
West-thorn Colliery, 1 pumping engine, 26; 3 winding engines, 1 of 14, and 2 of 13 each, - - - - - - - - - - - -	66
Dalmarnock Colliery, 1 pumping and winding engine, 18, and 1 pumping, 46, - - - - - - - - - - - - -	64
Barrowfield Colliery, 2 pumping and winding engines, 1 of 26, and 1 of 14; 1 pumping engine of 20, - - - - - - - - -	60
Prockiemuir Colliery, 1 pumping engine, 29; 1 winding engine, 12, -	41
Gairbraid Colliery, 1 pumping engine, 18; 2 winding, 1 of 8, and 1 of 4,	30
Dalbeth Colliery, 1 pumping and winding engine, - - - - -	24
Belvidere Colliery, 1 pumping and winding engine, - - - - -	22
Hillhead Colliery, 1 pumping engine, - - - - - -	8
East Woodside Colliery, 1 pumping and winding engine, - - -	4
Total, - -	1411

Total,—Collieries, 18.—Engines, 58.—Average power of Engines, $5\frac{327}{1000}$.

Steam Engines in Stone Quarries.

	Horse power.
Westmuir,	11
Garscube,	6
Kelvinholme,	6
Firework,	4
Possil,	4
Kelvinhaugh,	4
Eastfield,	4
	39

Total,—Quarries, 7.—Engines, 7.—Average power of Engines, $5\frac{571}{1000}$.

General Abstract.

	Number of Engines.	Horse power.
In Manufactures,	176.	2970
In Collieries,	58.	1411
In Stone Quarries,	7.	39
In Steam Boats,	68.	1926
In Clyde Iron Work,	1.	60
Totals,	310	6406

Average power of Engines, $20\frac{664}{1000}$.

The difference of cost between the price of coals consumed by Steam Engines and the keep, &c. of horses, must ever vary with circumstances. The following will give some idea of the difference:—A heavy horse, working ten hours, will consume 15 lbs. avoirdupois of oats, and 14 lbs. of hay per day—an Engine of 30 horse power, working 10 hours per day, in a mill, will consume, on an average of summer and winter, about 4 tons of coal dross. The Steam Boat, Toward Castle, from Glasgow to Rothsay and back again, a distance of about 80 miles, consumes five and a half tons of hard coals in 12 hours.

ON VARIOUS CEMENTS.—By Thomas Gill.

Yates's Water-Proof Glue or Cement.

Take of the best Irish glue, four ounces; and of isinglass, two ounces: these must be dissolved in mild ale (*not stale,*) over a slow fire, in a common glue-kettle, to the consistence of strong glue; when one ounce and a half of well-boiled linseed oil must be gradually added, and the whole well incorporated together by stirring. To increase the strength of the glue, more isinglass may be added.

This cement is applicable to the joints of wood, in every branch of manufacture; as also to joining earthenware, china and glass—care being taken to press the parts well together, and to allow them sufficient time to set.

The cement, when cold, and made into cakes, assumes the appearance of India-rubber; and like it, is elastic. It may at any time, when wanted for use, be dissolved, by a gentle heat, in any proper iron or glazed earthen-vessel; first putting into it a little mild ale, to prevent it from burning at the bottom of the vessel; and adding more ale, to bring it to a proper consistence for use. To cement leather together, for harness, bands for machinery, &c., having prepared the joints in the usual way, as if for sewing, apply the cement while hot, laying a weight upon each joint, as it is made: let them remain six hours before using, and the joints will then become nearly as firm as if made of one entire piece of leather. An excellent cement for stopping leaks in casks, &c. may be made by putting a little tow to the other ingredients.

Glue and Rosin Cement.

Two parts of glue and one part of rosin are to be melted together; and a sufficient quantity of red-ochre added, to colour it.

This cement is used to cement hones into their wooden-frames, and appears likely to be useful for many other purposes.

Glue and Linseed-Oil Cement.

Strong glue, well made with water, one pint; and one-eighth of a pint of linseed oil added to it, drop by drop, whilst boiling.

With this glue or cement, the joiners unite the parts of sign-boards, or other works which are to resist the effects of moisture.

On the Gum-Ammoniacal Cement.

This cement is formed by adding to a solution of gum-ammoniac in proof-spirit, some isinglass or parchment-glue, and uniting them in a gentle heat.

The chief value of this cement consists in the great readiness with which it melts in a small degree of heat, and the little tendency it has to be affected by moisture.

This cement is very much employed by entomologists, in joining together the dislocated parts of insects; for which purpose it is exceedingly convenient.

Isinglass Cement.

Isinglass, dissolved in brandy or proof-spirit, readily melts by a gentle heat, and forms a very useful and convenient cement.

Cement of Isinglass and Gum-Arabic.

This cement is composed of two parts of isinglass, and one part of the best gum-arabic, put into a bottle, and covered with gin or proof-spirit; and the bottle being loosely corked, is to be placed in a vessel of water, and boiled till the solution is effected; which may then be strained for use.

In this valuable cement, the isinglass and gum-arabic correct each other's defects; the isinglass giving to the gum toughness, and the gum increasing the hardness of the isinglass; and both together forming a most useful cement, particularly for mounting opaque objects for the microscope.

On the use of Wafers, as an extemporaneous Cement.

A great improvement in the manner of using wafers, so as to cause them to unite or hold papers together more firmly and neatly, is to divide or split them with a pen-knife, and thus to form two wafers out of one, of only half the usual thickness. These may be cut into small pieces, and applied by first wetting the paper in the places to be cemented, and laying a piece of wafer on each; and then wetting the pieces of wafer, over which the other paper to be united may be placed, and pressed close: thus perfectly effecting the union. A very cheap cement is thus readily obtained; and with white wafers, owing to the thinness of the split wafer, no marks will be seen, as is the case where the entire wafer is used: the union also is so perfect, as to render separation impossible, as is sometimes effected by splitting the entire wafer.

Improved Gum-Water.

It is well known that the mucilage of gum-arabic is exceedingly liable to become spoilt by keeping. If, however, the gum be dissolved in water, and made of a thick consistence, and a little alcohol added to it, that evil will be prevented; or the solution may be made at once, in gin or other proof-spirit.

This gum-water should be kept in a wide-mouthed glass vessel, with a ground stopper, to prevent the escape of the alcohol. And although it has not the strength of the above described cement, which is composed of gum-arabic and isinglass, yet it is very serviceable for many purposes, especially as it does not require to be heated before using.

A very convenient way of applying it to the cementing of small labels on specimens of minerals, &c. is, by forming an instrument of a small common pin, stuck a little way into a slender pointed han-

* A good cork is much better, as the stopper will become firmly cemented. —Editor.

dle of wood: the head of the pin, on being dipped into the gum-water, takes up a sufficient quantity at a time: and it may then be applied, in a small spot, to each end of the label, which is generally sufficient to secure it to the specimen.

On Shell-lac, as a Cement.

This article is largely employed by the hair-workers in jewellery, to cement the hair into the collets, and thus to form it into bracelets, &c. The mode of using it is as follows:—The shell-lac is put into a basin, and the basin placed in a Dutch-oven, which is set before an open fire, until the shell-lac becomes melted by the effects of the gentle heat thus applied, and can be drawn out into slender threads or rods fit to enter the small collets.

To use it, the collets must be warmed sufficiently to melt the shell-lac, *but not more;* as its utility greatly depends upon the volatile parts being preserved, which are quickly dissipated by too great heat. The hair is then to be placed within the collets, and thus firmly secured.

In like manner, with shell-lac, the ruby cylinders of watches are firmly cemented in their sockets, by the watch-jewellers.

On Copal, Amber, or Gum-Mastich, as extemporaneous Cements.

These substances may be employed in their natural state, much in the same way as the shell-lac, forming exceedingly hard and durable cements. The jewellers use the last-mentioned article in uniting the two stones which form their *doublets;* although it would seem that copal would much better answer that purpose, from its greater hardness. Amber, also, where its colour is no objection, is yet fitter than either to effect this object, on account of its still greater strength.

On Glue, as an extemporaneous Cement.

This article, sawn into slips, is of great use to artists, in cementing paper, vellum, &c. to their drawing boards, in the following manner.

The paper, &c. being damped upon its back, by means of a wetted sponge, and laid upon the drawing-board, the end of the slip of glue is to be dipped into hot water, and rubbed between the edges of the paper and the drawing-board, so as to apply a slight coat of stiff glue to both: the paper is then to be rubbed down hard upon the board, until the union is effected; and, in case of the paper becoming loosened in places by its stretching and tightening as the water evaporates, the same process is to be repeated.

When the drawing is completed, the paper, vellum, &c. may be readily taken off the board, by inserting an ivory folding-knife between it and the board. And what little still remains adhering to the board, may be removed, previously to cementing another paper upon it, with a sponge and hot water.

Varley's Cement.

Take sixteen parts, by weight, of black rosin, the same quantity of whiting, and one thirty-second part of bees-wax.

The whiting finely powdered, must be previously heated red-hot, to expel all moisture; and be suffered to cool, before adding it to the melted rosin and bees-wax.

This cement is exceedingly useful in the various mechanical arts, and particularly in turning in general, for the purpose of cementing articles to chucks, &c. in the lathe. It is also used in watch-jewellery, to hold the rubies, &c. fast, in turning and drilling them in the lathe: for this purpose, however, Mr. Seymour, formerly a workman of Mr. Varley's, thinks that *chalk* in its natural state, finely powdered, is preferable to the washed chalk or whiting; and he also varies the proportion of the bees-wax, according to the warmth or coldness of the weather.

It will be seen that the *rosin* forms the chief binding ingredient in this cement; the bees-wax being added merely to give it toughness.

Glue from Tanned Leather.

It is generally thought that the process of tanning, renders leather exceedingly insoluble. Means, however, have been found to overcome that insolubility, and to form a glue exceedingly well adapted to the purpose for which it has hitherto been used; namely, that of making the *black paper cases*, so much used for a great variety of purposes; as it not only forms the cement by which they are glued together, but also, in consequence of the gallic-acid contained in it, strikes a black colour, by the application of a solution of sulphate of iron (green vitriol, or copperas) to the surfaces of the articles; and lastly, serves to varnish the cases.

The process for making this glue is as follows:— Boil the scraps or cuttings of thin tanned leather; such as the upper leathers of boots, shoes, &c. are made of, in stale urine, until they become softened, and will stretch and contract, when pulled and let go again, in the manner of India-rubber: they are then to be washed in clean water, and boiled in water until dissolved to a proper consistence for use.

It is very singular that this useful process has been hitherto confined to the above branch of manufacture; and has never, to the best of the Editor's knowledge, been before published.

*On the French Glue from Bones.**

This is made at Paris, by M. Robert, in the following manner: The bones used, are those only which, previous to this discovery, answered no useful purpose except for the fabrication of phosphorus, ammonia, animal charcoal, bone-ashes, or manure; such, for in-

* Extracted, with alterations, from Silliman's Journal of Science and the Arts.

stance, as those of the head, ribs, &c. The refuse of the legs of sheep and calves, &c. which had been already partly used for the purposes of the toy-men, (*tabletiers*) are also used for this purpose, after extracting as much of the gelatine and fat as can be done by ebullition. When the heads of oxen are to be operated upon, they begin by extracting the teeth, (these being reserved for the fabrication of ammonia, as affording a greater proportion of that alkali than any of the other bones:) they then break the skull, in such a manner as to preserve all the compact parts in as regular forms as possible; these pieces present a surface of from twenty to thirty inches square, and are put to soak in a mixture of muriatic acid and water. The muriatic acid used, marks about 23° of the *areometer*, and is diluted by water to about 6°. Four parts of the liquor is used to one part of the bones. They are left in this state, in open vessels, until a complete solution of the phosphate of lime has taken place, and the gelatinous part of the bone remains in its original shape and size, and is perfectly supple. When this operation is finished; which commonly lasts six or eight days, the gelatine is put into baskets, being first drained; and is immersed a short time in boiling water, in order to extract any small remains of grease, which would deteriorate the gelatine; and also to extract any of the acid which might be lodged in the pores. It is then carefully wiped with clean linen, and afterwards washed in copious streams of cold water, to whiten it, and render it more transparent: it is then put to dry in the shade. This is used for making glue of a very superior quality.

The inside of the bones of sheeps' legs, furnish a sort of membranous glue, which supplies with advantage, the place of isinglass, in the fabrication of silk stuffs.

Remarks on this Process.

Glue is generally made in this country, as is well known, from the skins of animals. The Editor would, however, wish particularly to call the attention of persons to the great superiority, in point of strength, of the glue made from bones, over the best English glue; as appeared from various trials made with it by a skilful English workman at Paris, in comparison with that of the best glue made in England; and on the result of whose experiments he has every reason to place absolute confidence. It surely is highly necessary that endeavours should be made in this country, with a view of re-establishing the preference hitherto shown to the English glue: and, indeed, there has lately been a Patent taken out for a new method of manufacturing glue from bones, by means of steam.

On the Processes of Tanning, Leather-Dressing, and Dying, &c. from Aikin's Dictionary of Chymistry.

The preparation of the skins of animals for the many important purposes to which they are applied, is, almost exclusively, in all its branches, a chymical process.

The art of preparing leather is unquestionably one of the most ancient known, and is practised in every country on the face of the globe, with a general similarity of method, the result of obvious reasoning and long experience.

The objects fulfilled in converting skin into leather, are to prevent the destruction by putrefaction, which unprepared skin would undergo, (though slower than with most other parts of animals) and to render it strong, tough, and durable, and in some instances impervious to moisture.

The recent skin stripped off an animal, consists principally of the true cutis, or membraneous texture; the chymical composition of which is gelatin in a dense state, but still entirely soluble in water, more or less easily, according to its density. This however is penetrated with different vessels for blood, lymph, oil &c., some of the contents of which, must of necessity, remain after the death of the animal, and is covered on the outside with the insensible cuticle, to which is attached the exterior covering of hair, wool, fur, and the like. The chymical composition of the cuticle and its investing hairy covering, appears to be condensed albumen, insoluble in water, and nearly incapable itself of putrefaction, but readily separable from the true skin by slight mechanical violence, after the adhesion has been weakened by incipient fermentation or putrefaction, or the chymical action of lime, alkalies, or acids.

The preliminary steps of all the processes for making leather consist in separating from the cutis, adhering impurities and foreign matters, the animal juices retained in its pores, and the cuticle with its hairy covering; (except in the very few cases, in which the latter is purposely left on.) The true skin being thus obtained nearly pure, and its texture so far opened as readily to imbibe any substance in which it is macerated, is then converted into leather in different methods, of which there are two quite distinct from each other; namely, that of *tanning*, or impregnating it with the peculiar vegetable matter called tan; and *tawing*, in which it imbibes alum and other salts, and afterwards some soluble animal matter, such as the white of egg, or sometimes blood. These two processes are also sometimes combined, that is, first by tawing, and afterwards finishing with a slight tanning. A large portion of the tanned leather also undergoes the farther operation of *currying*, or imbuing with oil of some kind, with much manual labour, in order to render it supple, flexible and still more impenetrable by water. As familiar examples of each, the thick sole leather of shoes is *tanned;* the white kid leather, as it is called, for fine gloves, is *tawed*; the upper leather, for boots and shoes, is *tanned* and *curried*; and the fine Turkey leather is *tawed*, and afterwards finished with a slight *tanning*.

The slight variations in the preparation of different kinds of leather, are so numerous, that only some of the leading processes can be here described.

Tanned Leather.—All the skins undergo a considerable pre-

paration before they are fit to receive the tanning lixivium. In most parts of England the process is the following, for the thin skins of cows, calves, and those that are used for the more flexible kinds of leather; most of which is afterwards finished by currying: the hide is first thrown into a pit with water alone, to free it from loose dirt, blood, and other impurities. After lying there for a day or two, it is placed upon a solid half-cylinder of stone, called a *beam*, where it is cleared of any adhering fat or flesh. It is then thrown into a pit containing lime and water, in which it is kept for several days, with frequent stirring. The use of this is to loosen the hair and cuticle; after which the hide is again stretched on the beam, and the hair entirely scraped off with a blunt knife made for the purpose.* The hide being well freed from the lime, is then put into a pit called the *mastering*-pit; which is a bath composed of water and the dung of some animal, generally hens, or pigeons, or dogs, or, where it can be had, of sea-fowl, diffused through the water. The dung of horses or cows will not answer, not being sufficiently putrescent. Here the hide remains for some days, more or less, according to its texture; and from being hard and thick, (the effect of the lime-water,) it becomes very soft and supple. Where the hide is very thin and fine, extreme care is requisite in regulating this part of the process; for the putrescent dung is found so powerful an agent, that if the skin is kept in it only a few hours too long, its texture is irrecoverably destroyed, and it is reduced to a gelatinous mass, which pulls to pieces with the slightest force. The hide is then thoroughly cleaned on the beam, and is fit for tanning.

The large thick ox or boar's hides, intended for the toughest sole-leather, or where a very strong leather is required, are prepared in a different way. Being first cleaned in water, they are sometimes rolled up in heaps, and put into a warm place, where they speedily begin to putrify. The hair is then loosened, and may be scraped off sometimes with, and at other times without, the process of liming. The reason why the liming is generally omitted is, that the lime, if retained in the skin, renders it too hard, and liable to crack; and it is not so easy to wash it out from these, as from the thinner hides. But on account of the thickness of the hide, and the closeness of its texture, it is not fitted to receive the tan liquor till its pores are more completely opened; and this is usually done, by immersing it for several days in a vat

* In some tanneries the hair is loosened without the use of lime, the skins are piled together and covered with spent bark; in this situation, a fermentation takes place, which so far decomposes the cuticle, as to allow the hair to be easily scraped off. This is found to be a great improvement, but great care is required in its management, for if the fermentation is allowed to proceed too far, the texture of the skin will be injured. The length of time required for the completion of this process, varies with the weather and other circumstances; the pile is frequently examined, and the skins removed, as soon as the hair is loosened. Not the slightest injury is produced, and the business is greatly facilitated.—Editor.

containing a sour liquor, an impure acetous acid, formed from rye or barley flour, strongly fermented. The acid generated in the process, seems to be a principal agent in opening the texture of the skin; but this is, doubtless, assisted by the continuance of the fermentation, of which the skin itself partakes. This process is called *raising*, and it always immediately precedes that of tanning. Here, also, much care is required not to weaken the texture of the skin too much, for if kept too long in this process, it would be corroded and spoiled. The hide comes out of this bath considerably swelled and softened.

Instead of this part of the process, which is often difficult to manage properly, on account of the effect of the weather, and other external causes, on the necessary fermentation; Dr. Macbride has proposed the use of sulphuric acid, extremely diluted, and this appears now to be pretty generally adopted. The proportions employed, are about a wine pint of oil of vitriol to fifty gallons of water. Though the vitriolic bath is found to have as good an effect as the rye and barley sourings, in preparing the hide for the tan, the action of the two substances seems to be considerably different. In the latter the acetous acid is doubtless the chief agent, but the fermentation still continues, as is proved by the readiness with which the skin are rotted, if this is too high, or too long continued. The skin also, after raising in this way, is thickened and softened. But the vitriolic bath is incompatible with any fermentation, and most powerfully checks this process, and hence the skin is not readily spoiled by very long immersion, and it comes out thickened and hardened. It should seem, however, that each method answers perfectly well.

The next process is that of *tanning;* which is essentially the same for all skins, however previously prepared; and is founded on the following chymical facts. A great variety of vegetable substances, that is, all those that give an astringent taste when chewed, (such as the bark of oak, willow, alder, and many other trees, the gall-nut, tea-leaves, &c. &c.) when macerated in water, hot or cold, yield to this menstruum a substance, eminently astringent, of a grayish white when pure, which is called *tannin* or *tan*. When any kind of skin is immersed in an infusion of tan, it gradually absorbs or extracts it from the water in which it is dissolved, and the skin thereby becomes of a firmer texture, sensibly heavier, no longer capable of putrefaction or any spontaneous change, less easily pervious to water, and no longer soluble in this fluid, even at a boiling heat, which all untanned skin is, whatever be its previous preparation. The art of tanning, therefore, essentially consists in nothing more than immersing skin, for a sufficient length of time, in an infusion of tan from vegetable bark, or other sources, till it is completely saturated with this principle. Hence, the art of preserving the hides of animals by this method, is one of the most ancient and universal of all manufactures; no apparatus whatever being required to perform it, except a pit or hole for water, in which the tanning vegetable may be

put, and the skin, thrown in along with it. And even in the most careful and improved methods of tanning, almost equal simplicity is observed in the operation, except that some art is used in regulating the strength of the tan-infusion, and some little manipulation in stirring the hides, to give every part an opportunity of being thoroughly and equally soaked.

The substance used for tanning in this country is almost invariably oak-bark. The timber being felled in spring, (when the sap has risen,) the bark is stripped off, and piled in large stacks, protected from the wet by a shed; but open at the sides, to admit a free circulation of air through it. The bark, before using is ground into coarse powder, and is thrown into pits, with water, by which an infusion of the tan, and other soluble parts is made, which is technically called *ooze*. The hides, previously prepared in one or other of the ways above mentioned, are then first put into small pits, with a very weak ooze, where they are allowed to macerate for some weeks, with frequent stirring, or *handling*, as it is called. The strength of the different oozes is increased gradually, after which the half-tanned hides (if of the thick kind intended for sole leather, and which require very complete tanning) are put into larger pits, with alternate layers of ground bark, in substance, till the pit is filled, over which a heading of bark is also laid, and the interstices filled up with a weak ooze to the brim. The hides are thus exposed to the full action of an ooze nearly saturated with tan, and supplied with more of this principle from the bark in substance, in proportion as the skin absorbs that portion already dissolved, till the tanning is judged to be complete. This, for the heaviest kind of leather, requires never less than fifteen months. Skin is known to be fully tanned by cutting a small piece off the edge of the hide and observing the change of colour. As far as the tan has fully penetrated, the colour is of a nutmeg-brown, but the rest is white; and therefore, before the process is complete, the upper and under sides are brown, and a white line or streak is seen in the middle.

[TO BE CONTINUED.]

GLAZING EARTHENWARE.

M. Rochinski, a manufacturer of earthenware at Berlin, has found a varnish or glazing for common pottery, which, after trials made in the presence of the College of Medicine, offers no danger in regard to health, and resists the action of acids. This glazing is composed of five parts of litharge, two parts of well purified clay, and one part of sulphur. These substances are pulverised, and mixed with a sufficient quantity of caustic alkaline lie, (soap-maker's liquor,) so as to form a mixture fit to be readily applied on the earthenware, and to cover it equally all over. Carefully baked, these wares offer no trace of lead.

COMPOUNDS OF METALS.

An excellent practical work has been recently published in England, entitled "THE OPERATIVE MECHANIC & BRITISH MACHINIST, by *John Nicholson*, Esq. Civil Engineer." From this we shall frequently make extracts for the pages of our Journal; as, by so doing, we shall diffuse valuable information, on many important operations in Mechanics, given by a gentleman who, evidently, well understood the subject upon which he has undertaken to write.—The following receipts are from the appendix, to the above mentioned work.

Fusible Metal. No. 1.—4 parts of bismuth,
2½ parts of lead, and
1¼ parts of tin.

Put the bismuth into a crucible, and when it is melted, add the lead and tin. This will form an alloy, fusible at the temperature of boiling water.

No. 2.—1 part of zinc,
1 part of bismuth, and
1 part of lead.

This alloy is so very fusible, that it will melt and remain in a state of fusion, if put upon a sheet of paper, and held over the flame of a candle or lamp.

No. 3.—3 parts of lead,
2 parts of tin, and
5 parts of bismuth,

Will form an alloy fusible at 197° Fahrenheit, peculiarly applicable to casting, or the taking of impressions from gems, seals, &c. In making casts with this and similar alloys, it is necessary to use the metal, at as low a temperature as possible; otherwise the moisture adhering to the things from which the casts are to be taken, forms vapour, and produces bubbles. The fused metal should be poured into a tea-cup, and allowed to cool, till just ready to set at the edges, when it must be poured into the mould. In taking impressions from gems, seals, &c. the fused alloy should be placed on paper or pasteboard, and stirred about till it has, by cooling, attained the consistence of paste, at which moment the die, gem or seal, should be stamped on it, and a very sharp impression will then be obtained.

Bath Metal is a mixture of 4½ parts of zinc, with
16 parts of brass.

Brass is composed of 3 parts of copper, and
1 part of zinc.

But brass that is to be cast into plates, for the purpose of making sheet brass, and of drawing into wire, must, instead of using the zinc in a pure state, be composed of
56 parts of the finest calamine, or ore of zinc, and
84 parts of copper.

Old brass, which has been frequently exposed to the action of fire, when mixed with the copper and calamine, renders the brass far more ductile, and fitter for the making of fine wire, than it would be without it; but the German brass, particularly that of Nuremberg, is, when drawn into wire, said to be far preferable to any made in England, for the strings of musical instruments.

Pinchbeck. No. 1.—5 parts of pure copper, and
1 part of zinc.

The zinc must not be added till the copper is in a state of fusion. Some use only half this quantity of zinc, in which proportion the alloy is more easily worked, especially in the making of jewellery.

No. 2.—1 part of brass,
2 parts of copper,

Fused together, under a covering of charcoal dust.

Prince's Metal. No. 1.—3 parts of copper, and
1 part of zinc,
Or, 8 parts of brass, and
1 part of zinc.

No. 2.—4 parts of copper, and
2 parts of zinc.

In this last, the copper must be fused before the zinc is added. When they have combined, a useful and beautiful alloy is formed, called Prince Rupert's Metal.

Bell Metal. No. 1.—6 parts of copper, and
2 parts of tin.

These proportions are the most approved for bells, throughout Europe, and in China. In the union of the two metals, the combination is so complete, that the specific gravity of the alloy is greater than that of the two metals, in their uncombined state.

No. 2.—10 parts of copper, and
2 parts of tin.

It may, in general, be observed, that a less proportion of tin is used for making church-bells, than clock-bells; and that a little zinc is added for the bells of repeating watches, and other small bells.

Tutania, or Britannia Metal.

No. 1.—4 parts of sheet brass, and
4 parts of tin; when in fusion, add
4 parts of bismuth, and
4 parts of regulus of antimony.

This is the composition or hardening, that is to be added at discretion, to melted tin, until it has required the requisite degree of colour and hardness.

No. 2.—Melt together 2 parts of sheet brass,
2 parts of tin,
2 parts of bismuth,
2 parts regulus of antimony.
2 parts of a mixture of copper and arsenic, either by cementation or melting.

This composition is to be added, at discretion, to melted tin.

No. 3.—1 part of copper,
1 part of tin, and
2 parts regulus of antimony, with or without a little bismuth.

No. 4.—1 part of sheet brass,
4 parts regulus of antimony, and
20 parts of tin.

German Tutania.—½ a part of copper,
2 parts regulus of antimony, and
24 parts of tin.

Spanish Tutania. No. 1.—4 parts of scrap iron, or steel,
8 parts of antimony, and
1½ parts of nitre.

The iron or steel must be heated to a white heat, and the antimony and nitre must be added in small portions. Melt and harden 1 lb. of tin with two oz. of this compound.

No. 2.—Melt together 1 part of antimony,
¼ of a part of arsenic, and
8 parts of tin.

The first of these Spanish alloys would be a beautiful metal, if arsenic were added.

Engestroom Tutania.—4 parts of copper,
8 parts of regulus of antimony, and
1 part of bismuth.

When added to 100 parts of tin, this compound will be ready for use.

Queen's Metal. No. 1.—9 parts of tin.
1 part of bismuth,
1 part of antimony, and
1 part of lead.

This alloy is used for the making of tea-pots, and other vessels, which are required to imitate silver. It retains its lustre to the last.

No. 2.—100 parts of tin,
8 parts of regulus of antimony,
1 part of bismuth, and
4 parts of copper.

White Metal. No. 1.—20 parts of lead,
12 parts of bismuth, and
1 part of regulus of antimony.

No. 2.—16 parts of regulus of antimony,
4 parts of brass, and
5 parts of tin.

Common Hard white Metal.

32 parts of brass,
3 parts of zinc, and
1 part of tin.

Tombac.—16 parts of copper,
1 part of tin, and
1 part of zinc.

Red Tombac.—11 parts of copper, and
1 part of zinc.

The copper must be fused in the crucible before the zinc is added. This alloy is of a reddish colour, and possesses more lustre, and is of greater durability, than copper.

White Tombac.—Copper, and
Arsenic,

Put together in a crucible, and melted, covering the surface with muriate of soda, (common salt) to prevent oxidation, will form a white brittle alloy.

Query, on Tinning old Iron Vessels.

Mr. Editor.—Can you, or any of your readers inform me, whether any person in this city will undertake to restore the tinning upon cooking vessels of iron, from which it has been rubbed by use? The operation is, I know, easily performed on copper, but I have not been able to get the workmen to undertake it on iron, some of them have declared it to be impossible. Is this correct, and why? W.

PROPAGATING FRUIT TREES BY GRAFTING.

The best luting wherewith to cover the newly grafted scions, is composed of equal quantities of train oil and rosin, prepared in the following manner:—First, melt the rosin in an earthen vessel; then pour in the oil, and mix them well; to be applied, when cold, with a painter's brush. This composition is used in the north-west part of France (Bretagne) with great success. It has this advantage, that it never cracks, nor admits rain or wind to the grafts, which is the usual cause of their failing. It is more expeditiously put on than the common clay covering, and looks much neater; but what renders it more useful is, that the grafts covered with this composition, seldom fail. Scions laid under earth, or steeped in water for a few days, grow better than those taken from the parent tree. Grafting cherry or pear trees, should not be delayed later than the 17th of March.

Method of Moulding Figures in Wood, called Ligneous Stucco.

A clear size is to be made of five parts of Flanders, and one of fish glue, which are put separately into water, and mixed together, after having passed through a linen cloth, or fine sieve. The quantity of water cannot be stated, because all glues are not of the same strength; the sufficient degree of liquidity is only known by letting

the mixture get quite cold, when it should become a stiff jelly. A few trials will show the proper degree of strength. The glue thus prepared, should be heated until it becomes painful to hold the finger in it; a paste is then to be made of the dust of the wood intended to be moulded.

The dust should be made either with a fine rasp, or with the shavings of the wood dried in an oven, and pounded; or with sawdust sifted through a fine sieve. This paste is to be laid two or three tenths of an inch thick, in a mould of plaster or sulphur, the surface having been rubbed with linseed or other oil, in the same manner as when mouldings are taken in plaster. While this first paste is drying, another is preparing with the dust of the wood, which has not passed through the fine sieve, but through a coarse one. The mould is to be entirely filled with this second paste, which gives consistency to the first; it is then to be pressed heavily, so that the paste may receive all the forms of the mould. The mould is then left till the cast has become sufficiently dry; it may then be taken out without the danger of breaking.

The time for withdrawing the cast from the mould is easily known by its shrinking; but first it is necessary to take off all the composition that exceeds the height of the mould, with a knife; so that it may present a plain and smooth surface; the substance not being entirely dry is more easily cut than afterwards. These ornaments are afterwards glued on the furniture for which they are intended; and if designed to be of the same colour as the wood, a little spirit varnish should be used. Considerable attention is necessary, and the operator should be well acquainted with the process, to know when they are properly moulded. These ornaments are generally gilt, and remain very solid. Cabinet-makers could make tasteful and appropriate ornaments by using paste composed of different woods, than they now do, and with much greater ease, than by carving. [*London Journal.*

NEW MODE OF MANUFACTURING GLASS.

M. Legnay has invented a new method of manufacturing glass, without the use of alkali. He has obtained a *Brevet d'invention*, in France, and the following is the process:—Take 100 parts of dried sulphate of soda, 656 parts of silica, and 340 parts of lime, which has been exposed to the air. All these materials must be mixed with the greatest exactness. The furnace and the pots must be heated till they are of a reddish white colour, when the mixture should be put, in little balls, into the pot until it is filled. The mouth of the pot should then be stopped up, and with its contents introduced into the furnace; and as soon as it is perceived that the material has sunk in the pot, more of the same mixture must be put in, until the pot is filled with a melted vitrous substance. A strong fire must be continued, in order to obtain a complete fusion in as little time as possible. When the fumes diminish, small

portions must be taken out at different times, to ascertain whether the glass be sufficiently refined, which generally becomes so in about twenty-two hours. This glass is then fit for use: it may, without risk, remain double the time in the furnace.

Another mode proposed:—To take 100 parts of muriate of soda, well dried, 123 parts of silica, 92 parts of lime which has been exposed to the air, well mixed together, and fused in the same way as above described: in sixteen hours a good glass will be obtained, which will be fit for use, for any purpose that may be required.

[*Description des Brevets d'Invention*, vol. viii.

ENTERPRISE STEAM VESSEL.

By an extract from a letter, dated Cape Town, Oct. 14, we learn the above vessel has reached the Cape in safety; the commander, considering, though the voyage has been rather long, that he has fully established the practicability of a steam-vessel weathering the open ocean under all circumstances.

The experience that has been gained, will, in future, obviate many of the difficulties and disadvantages that have been sustained during this voyage of experiment. In the first place, the engines were not large enough for the tonnage of the vessel; for in the calmest weather, they were never able to make more than eight knots per hour.

Another mistake seems to have been the little regard paid to the sailing department; and certainly not the least, the inefficiency of the crew. It seems they met with extraordinary heavy seas, and head-winds; difficulties that might have been surmounted, but for the want of fuel, which ran short; thereby, causing them to steer in an indirect course, and losing ten days. The commander is very sanguine in favour of the undertaking, and feels convinced of the certainty of performing such voyages in safety.

The slavery to the crew, of shipping coals, will be removed, as it is intended to establish depots, and so only fill the coal boxes forward, which will suffice for fifteen days consumption: by this plan, the vessel will be enabled to stow a considerable quantity of cargo. Great praise is bestowed upon the excellence of the machinery; for in steaming for ten days together, there was only occasion for ten minutes stoppage, to oil its various parts. The vessel being forced to deviate from its course, put into St. Thomas's for water, and received the greatest civility from the Governor, who is a Portuguese General. [*London Journal.*

NEW PATENTS IN ENGLAND, SEALED, 1825.

To Augustus Count de la Garde, of St. James'-square, Pall Mall, in the county of Middlesex, in consequence of a communication made to him by a certain foreigner residing abroad, for a certain improved machinery for breaking

or preparing hemp, flax, and other fibrous materials—Sealed 24th November—6 months for enrolment.

To Joseph Eve, late of Augusta, Georgia, in the United States of America, but now residing at Liverpool, in the county of Lancaster, engineer, for his invention of an improved steam engine—24th November—6 months.

To Henry King, of Norfolk-street, Commercial-road, in the county of Middlesex, master mariner, and William Kingston, of our Dock Yard, Portsmouth, master millwright, for their invention and discovery of certain improved fids for top-masts, bowsprits, and all other masts and spars to which the use of the fid is applied—26th November—6 months.

To Richard Jones Tomlinson, of the city of Bristol, gentleman, for his invention of an improved frame-work for bedsteads and other purposes—26th November—6 months.

To Marc Lariviere, of Prince-square, Kennington, in the county of Surrey, machinist, for his invention of a certain apparatus or machinery to be applied to the well known stamps, fly presses, or other presses for the purposes of perforating metal plates, and for the application of such perforated metal plates to various useful purposes—28th November—6 months.

To William Pope, of Ball Alley, Lombard-street, in the city of London, mathematician, for his having invented certain improvements on wheeled carriages—3d December—6 months.

To William Pope, of Ball Alley, Lombard-street, in the city of London, mathematician, for his having invented certain improvements in making, mixing, compounding, improving, or altering the article of soap—3d December—6 months.

To Henry Berry, of Abchurch-lane, in the city of London, merchant, for his new invented improved method, in different shapes or forms, of securing volatile or other fluids, and concrete, or other substances, in various descriptions of bottles and vessels—3d December—6 months.

To Ezekiel Edmonds, of Bradford, in the county of Wilts, clothier, for his invention of certain improvements on machines for scribbling and carding sheep's wool, cotton, or any fibrous articles requiring such process—3d December—6 months.

To John Beever, of Manchester, in the county of Lancaster, gentleman, for his having invented an improved gun-barrel—3d December—6 months.

To Edmund Lascombe, of East Stonehouse, in the county of Devon, merchant, in consequence of communications made to him by a certain foreigner residing abroad, and discoveries made by himself, for a method of manufacturing or preparing an oil or oils extracted from certain vegetable substances, and the application thereof to gas light and other purposes—6th December—6 months.

To John Phillips Beavan, of Clifford-street, in the county of Middlesex, gentleman, in consequence of communications made to him by a certain foreigner residing abroad, for an invention of a cement for building and other purposes—7th December—6 months.

To Francis Halliday, of Ham, in the county of Surrey, Esquire, for his invention of certain improvements in machinery to be acted upon by steam—9th December—6 months.

To Joseph Chesseborough Dyer, of Manchester, in the county of Lancaster, patent card manufacturer, for his invention of certain improvements in machinery for making wire cards for carding woolen, cotton, tow, and other fibrous substances of the like nature, and also certain improvements on a machine for shaving and preparing leather used in making such cards—9th December—6 months.

To Robert Addams, of Theresa Terrace, Hammersmith, in the county of Middlesex, gentleman, for his new invented method of propelling or moving carriages of various descriptions on turnpike, rail, or other roads—14th December—6 months.

To Matthew Ferris, of Longford, in the county of Middlesex, calico printer,